Massachusetts Division of Fisheries & Wildlife

2018 Annual Report

Annual Report 2018

Massachusetts Division of Fisheries & Wildlife

Jack Buckley
Director (July 2017–May 2018)

Mark S. Tisa, Ph.D., M.B.A.
Acting Director (May–June 2018)

Table of Contents

About the Cover:
MassWildlife staff prepare to stock trout at Lake Quinsigamond in Worcester with the help of the public. Photo by Troy Gipps/MassWildlife

Back Cover:
A cow moose stands in a Massachusetts bog. Photo by Bill Byrne/MassWildlife

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ELECTRONIC VERSION

The Board Reports

Joseph S. Larson, Ph.D.
Chairperson

Overview

The Massachusetts Fisheries and Wildlife Board consists of seven persons appointed by the Governor to 5-year terms. By law, the individuals appointed to the Board are volunteers, receiving no remuneration for their service to the Commonwealth. Five of the seven are selected on a regional basis, with one member, by statute, representing agricultural interests. The two remaining seats are held by a professional wildlife biologist or wildlife manager and one representative with a specific interest in the management and restoration of wildlife populations not classified as game species. The Board oversees operations of the Massachusetts Division of Fisheries and Wildlife, reviews the agency's programs, and sets policy and regulations pertinent to wildlife in the Commonwealth.

The Board has continued its tradition this year of holding monthly meetings at locations around the state, holding public hearings on proposed regulatory changes, and addressing many issues of specific concern. While many different matters and issues are brought before the Board each year, most of its meeting time is spent in review and scrutiny of proposals for regulatory changes and of agency programs. The Board also incorporates brief reports or comments from the Commissioner of the Department of Fish and Game and from a representative of the Massachusetts Environmental Police in the agenda of every meeting. Anyone interested in the details of the monthly meetings of the Board is referred to the archive of approved Board meeting minutes the staff maintains on MassWildlife's website.

This report is organized topically, then roughly chronologically within each topic. This predictable structure allows relatively easy searching and comparison of the Board's annual reports year over year.

The Division of Fisheries and Wildlife began a new chapter toward the end of FY 18, when Director Jack Buckley formally announced his intention to retire, effective April 30, 2018, and the Board voted the appointment of Deputy Director Mark Tisa as Acting Director, effective Mr. Buckley's retirement. The Board members expressed their gratitude and admiration to the outgoing Director for his close involvement in developing his staff and his many accomplishments during his tenure, not only as Director but over his many years as Deputy Director in charge of Administration, primarily responsible for personnel, legislative relations, and the Natural Heritage and Endangered Species Program.

Administrative Matters

Board Elections

The Board held its annual election of officers during the October Board meeting, reelecting Dr. Joseph Larson to be the Chair, Mr. Michael Roche as the Vice Chair, and Ms. Bonnie Booth as the Secretary of the Board.

Review of MassWildlife's Funding Mechanisms

Director Buckley reviewed MassWildlife's major revenue sources and discussed the agency's finances in a brief presentation during the January meeting. In the ensuing discussion, the Director was asked what he thought the chances were of the Blue Ribbon Panel's recommendations [i.e., the federal Recovering America's Wildlife initiative] being passed into law. He said about 50%-50%, given the fact that the act would mandate a reallocation of existing leases rather than new federal revenue.

Adopted Regulations and Other Votes of the Board

321 CMR 3.02(4)(o); Wildlife Management Zones

Assistant Director for Wildlife Michael Huguenin provided the staff justification for and specific details of an exercise to clean up many of the boundaries of the state's Wildlife Management Zones in a public hearing during the September Board meeting. The Director then reported in December that no comments had been received in the public comment period and reminded the Board that the changes were of a clarifying, 'housekeeping' nature. He asked whether the

Board required any additional information before taking its vote; none was required, and the vote in favor was unanimous.

2018–2019 Migratory Bird Hunting Seasons
In February, the Board heard the staff's proposals; in April, it held the public hearing; and, at the close of the hearing, during a discussion of the proposal, it voted to change the proposed opening day in the Central Wildlife District back to the day after the opening in the Western District, so that the two districts had different opening days, as has been traditional. The Board then voted unanimously to adopt the regulation package. For the final regulations, see the Waterfowl sub-report in the Wildlife Section of this Annual Report on page 47).

Extended Archery Deer Season in Certain Zones
A public hearing was held the evening of the day of the April meeting to hear a presentation from staff and comments from the public on a proposal to extend the Archery Deer season to begin 2 weeks earlier in Wildlife Management Zones 10-14, for a total season of 6 weeks in those zones. In May, after a discussion and consideration of the comments received during the hearing and the written comment period, the Board voted unanimously to accept the change as proposed. For details of the final regulation, see the deer management sub-report in the Wildlife Section of this Annual Report on page 51).

2017 Annual Deer Review and 2018 Antlerless Deer Permit Allocation Recommendations
Deer and Moose Project Leader David Stainbrook presented the annual Deer Review to the Board at its June meeting. He also presented the staff recommendation for the 2018 Antlerless Deer Permit (ADP) allocations, which were unanimously approved by the Board. Please refer to page 53 in the Wildlife Section of this Annual Report for the details of the review and of the ADP allocations for 2018.

Proposals for New, Updated, or Amended Regulations

Leashing of Dogs and Restraint of Domesticated Animals on MassWildlife Wildlife Management Areas
Southeast Wildlife District Manager Jason Zimmer provided the Board with a detailed report during the January Board meeting on the staff's recommendation to require the leashing of dogs and the removal of dog waste on MassWildlife Wildlife Management Areas. At the March meeting, Mr. Zimmer provided the Board with a detailed analysis of the comments received during the hearing and the written comment period. He reported that the agency had received a total of 229 public comments on the proposed regulation, and stated that MassWildlife staff reviewed all of the comments and had prepared a summary for the Board's use and consideration. Based on a review of the public comments, MassWildlife staff offered recommendations for the Board to consider amending the proposed regulations to require all persons (including hunters and sporting dog trainers) to immediately collect dog feces within designated parking areas and within 100 feet of designated parking areas for disposal off-site, while maintaining the exemption from feces collection/removal for hunters and sporting dog trainers on the wildlife management area greater than 100 feet from designated parking areas, to add the word physical before the word leash in Subsection (i) to further clarify that a physical leash (and not a "virtual or electronic leash") is required, and to strike language from Subsection (ii) that staff agreed was vague and difficult to enforce.

After Mr. Zimmer's discussion, the Board members voted separately on each of three amendments (as above) to the proposed regulations. During the first discussion thereof, Mr. Foster disclosed that he was not voting nor participating in any way in any aspect of the matter because an advocacy group had used his name in a letter in support of the regulations, though without his knowledge or permission. All three votes were five members in favor (Dr. Van Roo was not in attendance), with a recusal from Mr. Foster.

Secretary Booth then moved that the entire regulatory proposal be accepted as amended; Mr. Winthrop seconded the motion. Chair Larson stated in the ensuing discussion that, after the hearing, he had been given a copy of the document used at Callahan State Park to establish a dog park as an example or model for MassWildlife to follow. He cited the authority under Ch. 21, sec. 17D, which allows DCR to create these dog parks. He thought this was a lot of responsibility for the DCR to have accepted, and, interested, he looked at the DCR website and found that the DCR has 20 dog parks distributed across the state, with opportunities to create formal dog parks on all its other areas. He reported that each one entails a substantial commitment

from proponents to raise funds and provide volunteer support. The final vote to accept was five members in favor, with the recusal from Mr. Foster.

Agency Program Reviews

Southeast Wildlife District Activities (Jason Zimmer)
July meeting

Western Wildlife District Activities (Andrew Madden)
August meeting

The Human Dimensions of Suburban Deer Management in Eastern Massachusetts (Susan McCarthy)
September meeting

Northeast Wildlife District Activities (Pat Huckery)
September meeting

Central Wildlife District Activities (Bill Davis)
October meeting

Eastern Spadefoot Population Introduction to the Southwick WMA: 2015–2017 Summary (Jacob Kubel)
November meeting

Restoration Ecology (Chris Buelow)
March meeting

Wood Turtle Conservation (Michael Jones)
April meeting

Coldwater Stream Restoration: Hamant Brook (Caleb Slater)
May meeting

Other Presentations on Topics of Interest to the Board

Canadian Wildfire Deployment

At the December meeting, Habitat Biologist Ben Mazzei and Connecticut Valley Wildlife Technician Chris Connors tag-teamed a detailed report to the Board on their deployment to the Elephant Hill Wildfire in British Columbia, Canada, in August 2017. They reported that they were part of the Massachusetts Interagency Wildfire Crew, made up of 20 firefighters: 14 from the Department of Conservation and Recreation, 2 from the Division of Fisheries and Wildlife, and 4 from the State of New Hampshire. Mr. Mazzei reported that it was an excellent opportunity to provide resources to areas of extreme need. He stated that it provided experience and training for MassWildlife and DCR firefighters for prescribed burning, and helped improve the efficiency, safety, and other technical aspects of prescribed fire on MassWildlife lands. It also gave them unique opportunities to work and strategize with firefighters from all over the world, including Canada, Australia, New Zealand, and Mexico. Perhaps most importantly, the deployment offered opportunities for advanced 'taskbook' certification, to help build MassWildlife's program with trained staff that is qualified on tasks that can only occur on actual wildfire, which is a relatively rare occurrence in Massachusetts.

Cabela's Donation Presentation

Then-acting Director Mark Tisa reported at the June meeting that he had been invited to a presentation event earlier in the month and made a short promotional video with Mr. Rich Gilbert, General Manager at the Berlin Cabela's, who presented the Acting Director at the store with 400 fishing rods and reels for MassWildlife in support of its Angler Education Program as part of Cabela's Gone Fishing initiative. Acting Director Tisa then introduced Sean Humphries, Assistant General Manager at Cabela's in Berlin. Mr. Humphries stated that the vision of Johnny Morris, founder of Bass Pro Shops and now owner of Cabela's, is to challenge families to get kids outside this summer to discover the joys of fishing with the Gone Fishing campaign, through which the company is donating 40,000 rods and reels to organizations that work with kids and sponsoring many free fishing and introductory fishing events in its stores across the country. Acting Director Tisa also commended MassWildlife Hunter Education Program Instructor Tim Bradbury, whose personal relationship with the local Berlin store staff ultimately led to the donation.

In October, the Board gratefully presented former DFG Commissioner and former long-time State Representative George N. Peterson Jr. with the Francis W. Sargent Conservation Award for his many contributions to the vitality of the sporting community and his decades of work devoted to conserving the Commonwealth's natural resources. MassWildlife held the award ceremony at its Westborough Field Headquarters, where many friends and former colleagues of Representative Peterson, including EEA Secretary Matthew Beaton, spoke of his passion for nature and the outdoors and his ability to work with diverse colleagues and organizations to achieve common ends throughout his career.

Fisheries

Todd A. Richards
Assistant Director, Fisheries

Overview

The Commonwealth possesses an enormous quantity and variety of freshwater fishing opportunities. Our lakes, ponds, streams, and rivers provide excellent fishing for warm and coldwater species of fish from Cape Cod to the Berkshires. Anglers can find themselves successfully catching bass, trout and panfish in urban settings or remote wildlife management areas. The enormous popularity of our freshwater fishery is not only a benefit to our anglers, but also to our economy, providing more than $100 million in wages, salaries, business earnings and state and federal tax revenues.

The Fisheries Section responsibilities include a mix of management and research activities designed to enhance and promote recreational opportunities and gain an in depth understanding of the fishery resource, its' status and trends. Fisheries activities require expertise in fisheries management, policy, and aquaculture.

This year our hatchery program once again provided one of the best trout fisheries in the Northeast despite some serious weather-related challenges. Sandwich Hatchery bore the brunt of 3 late winter storms. The actions of hatchery staff to minimize damage and protect hatchery infrastructure won them a nomination and receipt of the Department of Fish and Game Commonwealth Citation for Outstanding Performance. The dedication and professionalism of the Sandwich Hatchery staff is mirrored at all our trout hatcheries where the nearly 30 staff work hard every day to ensure the quality of the stocked trout fishery across the state.

The biological fisheries staff at MassWildlife also had a productive year. In addition to maintaining and growing one of the highest quality fisheries databases, the section assumed the lead in climate change responsibilities for MassWildlife. This role focused on review of and input to the State's Hazard Mitigation and Climate Adaptation Plan and the completion of Agency Vulnerability Assessments. Updates were also made to assessment tools used by the section to determine the status of large rivers systems. We have instituted novel projects on American shad, wild trout management, catch and release areas, lake and pond management, and landlocked salmon populations. We have also further developed bathymetry, pond maps and catch and release area maps to better promote our fishery.

Members of the section have also served on Committees for students in the UMass Cooperative Fish and Wildlife Research Unit, given talks to many educational institutions, participated in deer check station, trout stocking and controlled burn activities, and have helped to develop MassWildlife's R3 strategies.

Lastly, the section was instrumental in bringing a 10-year dam removal project to completion on Hamant Brook. The removal of 3 dams in the Town of Sturbridge will restore nearly a mile of former ponds to coldwater stream and improve water quality in the Quinnebaug watershed. Linking all of our activities like research, recreational fisheries, habitat restoration, and climate change adaptation will help us continue to promote and restore fisheries resources in Massachusetts.

I. Stream and River Project — Rebecca Quiñones, Ph.D., Project Leader

1. Assessment of warm- and coolwater stream and river resources.

Fifteen large streams and rivers were sampled in FY18 in collaboration with corresponding District staff (Table 1; total of 92 surveys). Data from surveys in the Chicopee, Concord, Hoosic, Housatonic, Nashua, and West Branch Farmington Rivers were used to calculate or recalculate indices of percent similarity to Target Fish Communities (TFC, as in Kashiwagi and Richards 2009, see Figures 1-6). Fish communities were categorized

as being in good (% similarity > 75), fair (% similarity = 50 to 75), or poor (% similarity < 50) condition.

Based on TFC analysis, conditions of fish communities in two rivers appear in poor condition (Chicopee and West Branch Farmington Rivers), as compared to worsening poor conditions in three rivers (Concord, Housatonic, Nashua Rivers) and fair and steady conditions in the Hoosic River. A similarity index for the Chicopee River was first calculated in 2017. Surveys in the mainstem Chicopee River suggest that current fish communities (Figure 1) are in poor condition (% similarity = 28.9) as compared to fishes in its reference streams. Data for the Chicopee River came from boat shocking surveys, a method not used in the calculation of indices for other river basins. Conditions for fish communities (Figure 2) in the West Branch Farmington River also appear in poor condition (2009 % similarity = 38.7 vs. 2017 % similarity = 42.7) but little changed in the last decade. Current fish communities (Figure 3) in the Concord River were likewise in poor condition (% similarity = 11.6) but seem to be in a degrading trend as compared to 2009 (% similarity = 38.2). The condition of fish communities in the Housatonic (Figure 4) and Nashua Rivers (Figure 5) also appear to be degrading (Housatonic: 2009 % similarity = 44.5 vs. 2017 % similarity = 29.4; Nashua: 2009 % similarity = 49.9 vs. 2017 % similarity = 16.9). Fish communities in the Hoosic River (Figure 6), in contrast, appear to be holding steady at fair condition (2009 % similarity = 68.7 vs. 2017 % similarity = 66.4). Potential factors (e.g., drought, urban development, temperature etc.) influencing trends at the basin level will be investigated in winter 2018/2019. TFC and similarity index information was shared with the Department of Environmental Protection for their assessment of Aquatic Life Use in rivers with cold and warm water fisheries (R. Maietta, pers. comm. 8/18).

Sampling in other locations was completed in order to meet requests for information (e.g., North Nashua River, Priest Brook) or to provide recent data at specific sites (e.g., Copicut River, Weweantic River). Additional sampling priorities were identified in collaboration with District biologists and in accordance with TFC needs. GIS shapefiles of survey locations were created for each district. These were given to S. Mattocks in February 2018 and incorporated into district-specific sampling requests.

2. Serve as the agency representative for climate change and climate science activities.

In FY18, 50% of designated hours were devoted to coordination and completion of climate change-related work, including review of and input to the State's Hazard Mitigation and Climate Adaptation Plan (SHMCAP). Completion of State Agency Vulnerability Assessments by the Department of Ecological Restoration, Department of Marine Fisheries, and the Office of Fishing and Boating Access was also coordinated in accordance with Executive Order 569: Establishing an integrated climate change strategy for the Commonwealth (signed by Governor Baker, 9/16/16). Additionally, several months were spent completing the State Agency Vulnerability Assessment for MassWildlife with input from Headquarters (9) and District (4) staff. A core group of eight MassWildlife staff met once to determine the 10 assets (things managed or owned) and 9 functions (services provided) most vulnerable to climate change (Table 2). Independent analyses and review of literature was then used to identify and score the exposure and sensitivity of each asset and function to 17 natural hazards (e.g., drought, landslides, coastal erosion) resulting from climate change drivers (i.e. sea level rise, precipitation, temperature, other extreme events). The agency's capability and adaptive capacity to address vulnerabilities, natural hazards and climate change was also evaluated.

The consulting firm AECOM used the assessment to write an agency-specific report that identified assets and functions rated with very high or high vulnerabilities (Table 2). Major findings of the assessment were presented to the Fish and Wildlife Board in July 2017 (FY19). Results were used to develop fifteen climate adaptive Priority Actions (Table 3) which will be included in the SHMCAP. Priority Actions included a variety of mitigation (e.g., protection of high elevation forests) and adaptation measures (e.g., upgrades to hatchery infrastructure, salt marsh remediation).

Another large effort in FY18 was the review of the Climate Project Screening Tool originally developed for the US Forest Service (available at https://www.fs.fed.us/psw/publications/documents/psw_rp263/) but adapted for MassWildlife by collaborators in the Northeast Climate Science Adaptation Center (T. Morelli et al.). This spreadsheet tool was developed to provide District Managers a quick method to determine

Figure 1. Comparison of observed (2017) and Target Fish Community (TFC) relative abundances of species habitat use and tolerance categories in the Chicopee River. FS=Fluvial Specialist, FD=Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

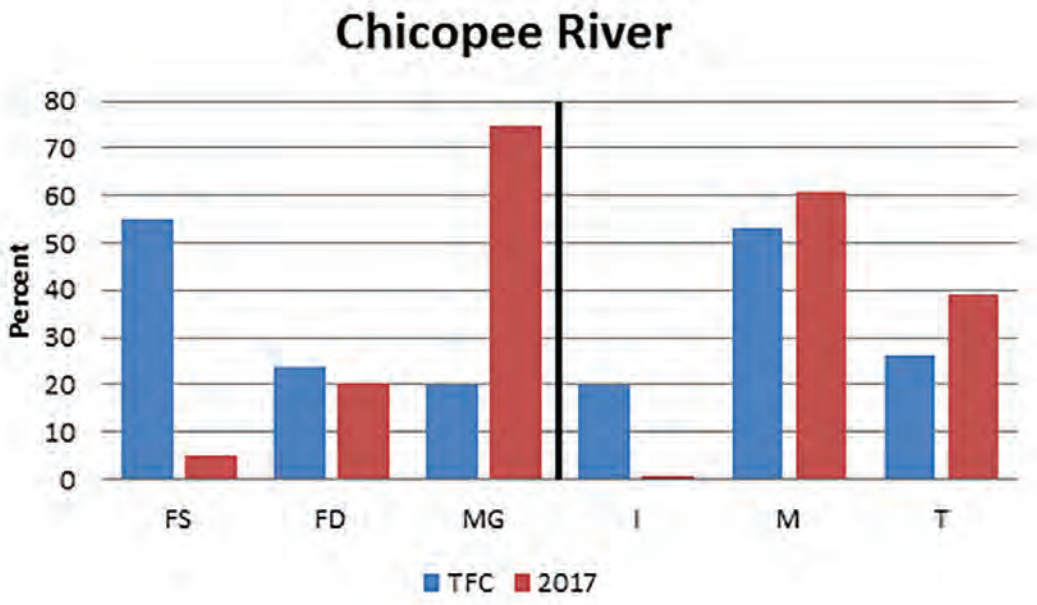


Figure 2. Comparison of observed (2017), Target Fish Community (TFC) and 2009 relative abundances of species habitat use and tolerance categories in the West Branch Farmington River. FS=Fluvial Specialist, FD=Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

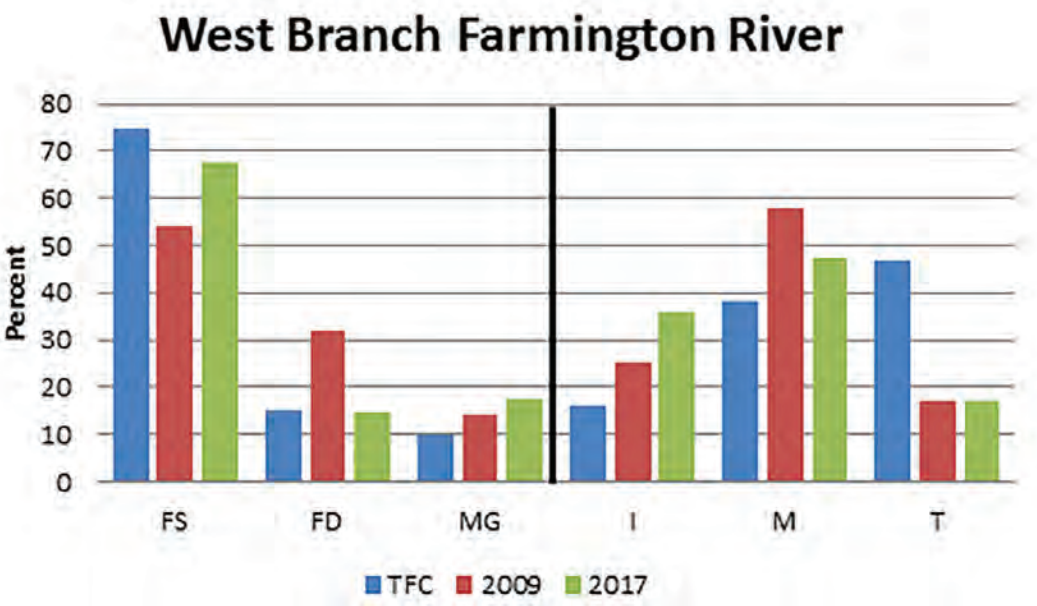


Figure 3. Comparison of observed (2017), Target Fish Community (TFC) and 2009 relative abundances of species habitat use and tolerance categories in the Concord River. FS=Fluvial Specialist, FD=-Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

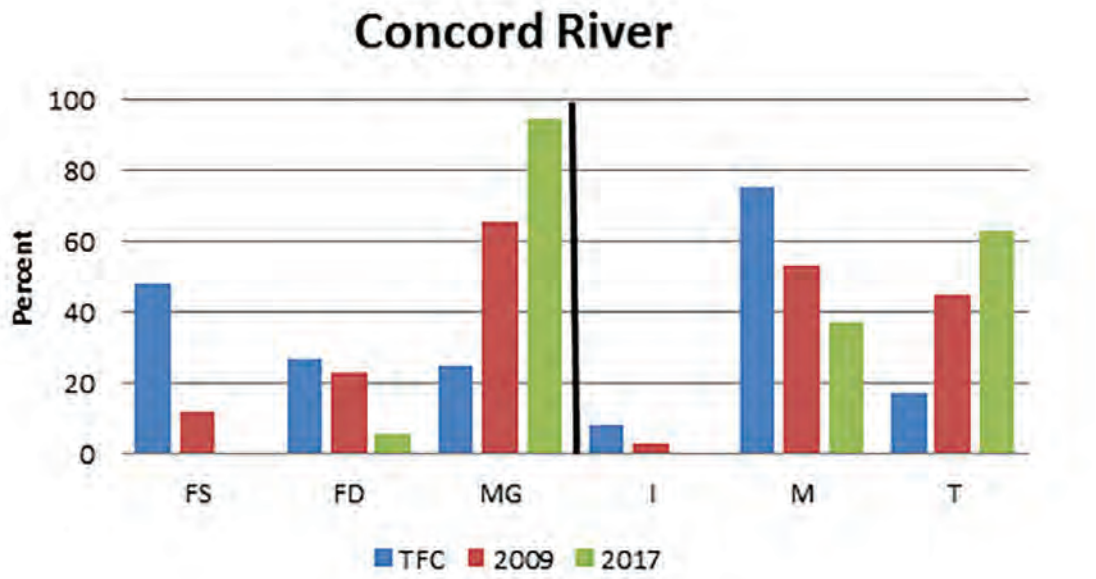


Figure 4. Comparison of observed (2017), Target Fish Community (TFC) and 2009 relative abundances of species habitat use and tolerance categories in the Housatonic River. FS=Fluvial Specialist, FD=Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

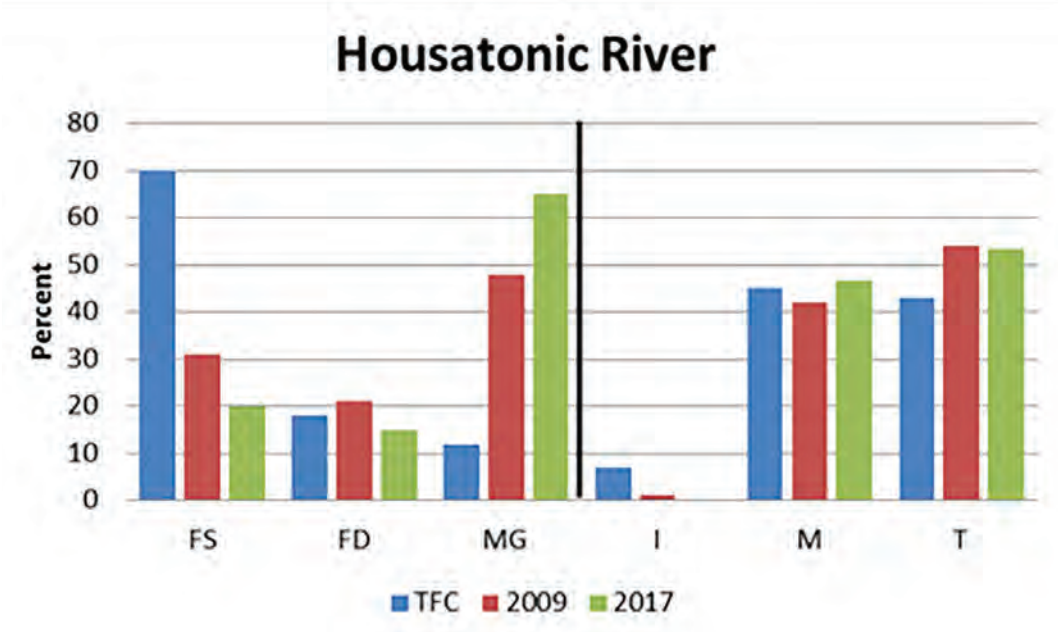


Figure 5. Comparison of observed (2017), Target Fish Community (TFC) and 2009 relative abundances of species habitat use and tolerance categories in the Nashua River. FS=Fluvial Specialist, FD=-Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

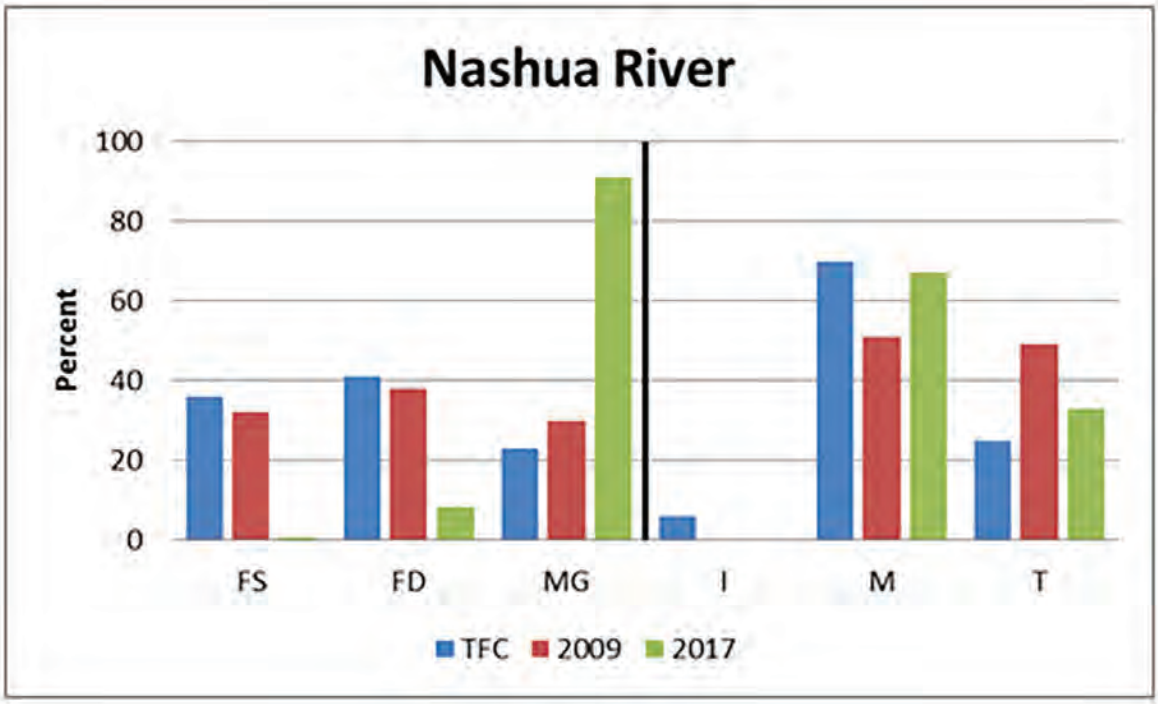


Figure 6. Comparison of observed (2017), Target Fish Community (TFC) and 2009 relative abundances of species habitat use and tolerance categories in the Hoosic River. FS=Fluvial Specialist, FD=Fluvial Dependent, MG=Macrohabitat Generalist, T=Tolerant, M=Moderately Tolerant, I=Intolerant.

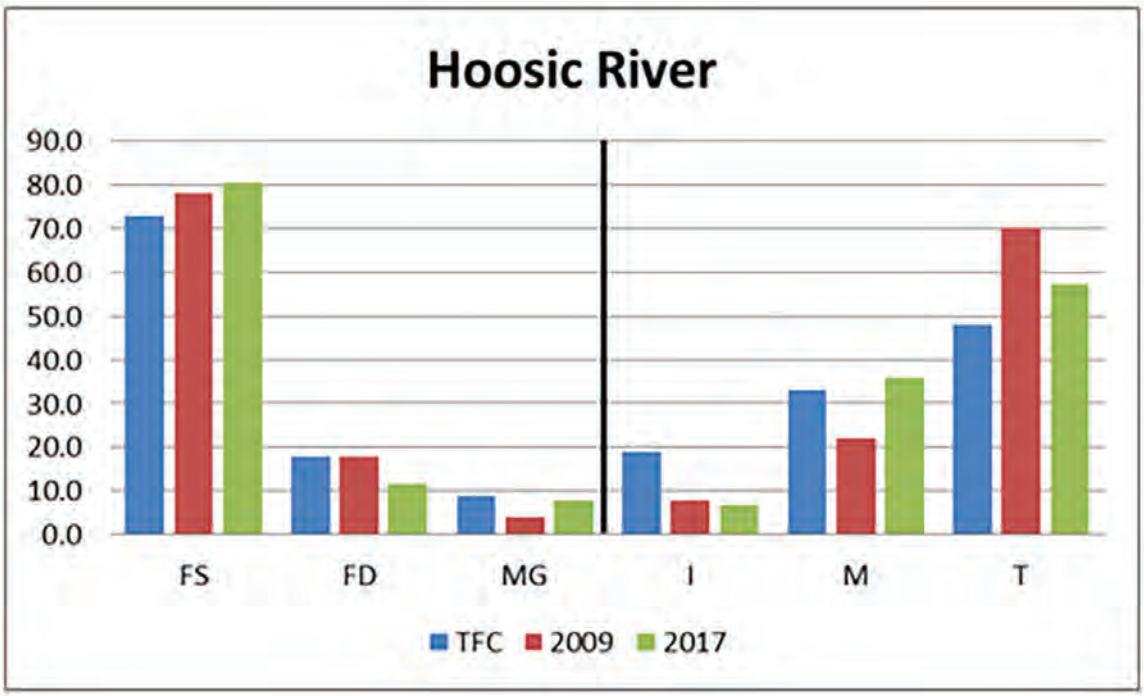


Table 1. Large streams and rivers sampled in FY18.

Waterbody		No. of surveys
Chicopee River		10
Concord River		8
Copicut River		3
Flat Brook		1
First Herring River		1
Hoosic River		10
Housatonic River		5
Nashua River		11
North Nashua River		6
Priest Brook		4
Quaboag River		5
Ware River		11
West Branch Farmington River		9
Westfield River		5
Weweantic River		3
	Total	92

Table 2. MassWildlife assets and functions with very high (VH), high (H), and moderate (M) vulnerabilities to climate change.

(Adapted from AECOM 2018. Division of Fisheries and Wildlife (DFW) Vulnerability Assessment Report, 2/27/18.)

		Rating
Asset	Managed lands	VH
	Records	H
	BioMap2 areas	VH
	Fisheries species	H
	MESA-listed species	VH
	Game species	M
	Hatchery infrastructure	VH
	Headquarters	H
	Other infrastructure (e.g., dams, roads)	H
	Other fish, wildlife, plant species	H
Functions	Stocking	H
	Education	M
	Habitat management	M
	Population management	M
	Ecosystem services	H
	Recreational opportunities	M
	Legal compliance	H
	R3 program	M
	Land protection	H

Table 3. Proposed MassWildlife projects identified as very high (VH) and high (H) Priority Actions for climate adaptation.

Very High	Identification of areas with high native aquatic biodiversity
	Coldwater climate refugia
	Shifts in species habitats and distributions
	Updates to BioMap2
	Impacts on common species
	Great marsh pilot ditch remediation project
	Mapping and control of invasive species
	Protecting habitat and infrastructure at barrier beaches
	Incorporating habitat and coldwater fisheries into DOT * assessments
	Land acquisition of high elevation habitats
	Mitigation of sea level rise at Sandwich Hatchery
High	Mitigation of warm temperatures at hatcheries
	Dam removal at Merrill Ponds Wildlife Management Area
	Mitigation of flooding at McLaughlin Hatchery
	Dam repair at Three Mile Pond Wildlife Management Area

* Massachusetts Department of Transportation

whether projects affected by climate change should proceed as planned or be modified. The review process included meetings with each of the District Managers and the staff of their choosing. Several hours were spent with each group using the tool to identify projects (e.g., mowing, prescribed burning, invasive species treatments) implemented in each of their Wildlife Management Areas. Most District Managers agreed that the tool was useful in providing a framework for thinking about the impacts of climate change but they identified disconnect between methods of project implementation and project creation and modification at Headquarters.

Time was also spent fulfilling duties in several official roles, including as the NEAFWA representative on the AFWA Climate Change Committee, as member of the Northeast Climate Adaptation Science Center's Science Advisory Committee, and as chair of MassECAN's (Massachusetts Ecosystem Climate Adaptation Network) coldwater streams expert working group. MassWildlife was also a primary planner and the host for the first all-day MassECAN conference (November 30, 2017). Lastly, several informal talks were given on the integration of resource management and climate adaptation at Boston College (September 19 and 21), Envirothon (November 15), Alewife corridor resiliency workshop (January 20), and Enviornmental Business meeting (March 15).

3. Serve as the MassWildlife Governing Council representative on the Instream Flow Council

In FY18, work continued as the Massachusetts representative to the Instream Flow Council's (IFC) Executive Council. A large amount of time was spent helping to plan and organize, as well as attend, a three-day workshop, FLOW2018: managing rivers, reservoirs, and lakes in the face of drought (Fort Collins, April 23-27). Additional duties as the IFC Secretary were added in April. The Secretary is in charge of taking and editing minutes for all Executive Council meetings, initiating approval of minutes at subsequent meetings, maintaining a roster and member list of all current IFC members, working with the IFC Treasurer to identify the active status of each participant, and sending out letters for fees due when appropriate.

4. Informs Assistant Director of activities, issues and potential problems and performs other fisheries research and management assignments as required.

Other fisheries research and management assignments in FY18 included:

1. Manning the fish kill phone as scheduled (3 weeks);

2. Providing help to Districts as needed
    a. Trout stocking (Western District)
    b. Surveys of Ashfield Pond and Laurel Lake (Western District)
    c. Surveys of Coonamesset River (Southeast District)
    d. Surveys of the Parker River (Northeast District)

3. Providing help to other staff as needed
    a. American shad surveys (Connecticut River)
    b. Lake trout surveys (Wachusett and Quabbin Reservoirs)
    c. Trout stocking (Wachusett Reservoir)
    d. Atlantic salmon and brown trout fin clipping (Palmer and Montague Hatcheries)
    e. Trout spawning (Palmer Hatchery)
    f. R3 meetings (2) regarding improvement of cultural awareness and communications
    g. Sportfishing awards entry review
    h. Sportsfishing awards ceremony (registration desk)

4. Providing technical review of projects in large rivers and streams or impacting warm water fisheries
    a. Dam removal in the Coonamesset River
    b. Dam removal in the Charles River (Watertown Dam)

Cranberry bog restoration (Department of Ecological Restoration)

II. Watershed Project - Jason Stolarski, Ph.D., Project Leader

<u>Major Projects</u>

Lake and Pond Sampling:

Examination of the MassWildlife fisheries database

showed that, over the past 20 years, lake and pond habitats have been sampled at a much lower frequency relative to stream habitats. To fill data gaps, but also to update pond summaries with current fisheries data the fisheries section has begun to focus on conducting lake and pond samples in greater frequency. Waterbodies are selected based upon access, stocking, and use and are then sampled using minnow traps, fyke net, beach seine, gillnet and/or boat electrofishing depending upon accessibility.

Where boat access is limited minnow traps and fyke nets are deployed on the first day within littoral habitats of the waterbody. All gear is marked with reflective buoys and left to fish overnight. Dissolved oxygen, temperature, conductivity, and pH are then measured at 1m intervals at the deepest point in the waterbody. The following day, sampling gear is pulled and all fish captured are identified to species, weighed to the nearest gram and measured to the nearest mm. Fish may also be captured using beach seine during this time as well. When access permits, boat electrofishing is used to sample littoral habitats of the pond and fish are processed as before. In general, the entire shoreline is sampled or as much of the shore as time permits.

Data are entered into a database, and checked for errors. Linear modeling is used to determine the relationship between log transformed weight and length for each species within and among (statewide) waterbodies. Residuals from statewide regressions for each species are used to eliminate outliers using quartile ranges. Relative weight is calculated from statewide weight-length regressions for each species and pond and in conjunction with CPUE used to evaluate the health of the fisheries community. As data are collected on additional waterbodies, these analyses will become more precise and permit more complex modeling. During the 2017 fiscal year, the fisheries section has conducted fisheries surveys on 31 waterbodies throughout the commonwealth (Table 1).

Lake Trout Sampling:

Lake Trout were initially stocked in Quabbin Reservoir in 1952 and began to enter the creel in 1956. Since then, populations have expanded into Wachusett Reservoir, and comprise arguably one of the most popular sport fisheries in the Commonwealth. Since the initial stocking, Lake Trout in Quabbin Reservoir have been monitored almost continually using various mark recapture methods most recently employing passive integrated transponder (PIT) tags beginning in 2006. Similar efforts commenced in Wachusett Reservoir in 2014. Each fall, spawning Lake Trout are sampled using 100 ft experimental gillnets set at night over known spawning locations. Nets fish for approximately 30 minutes and captured Lake Trout are gently removed from the net and scanned for the presence of a PIT tag using a PIT tag reader. If no tag is present, a 10mm PIT tag is implanted within the pelvic girdle of the fish. The unique tag number is recorded along with the length, and weight of the fish. Prior to release, the adipose fin is clipped to serve as a visual secondary mark.

Data are entered into a database, checked for consistency and general linear modeling is used to determine the relationship between log transformed weight and length within waterbodies and sexes. Relative weight is then calculated among waterbodies and sexes and used to evaluate and track changes in condition over time in both waterbodies. Growth rates are calculated from length changes garnered from recaptured fish and expressed as relative and absolute annual growth. However, because fall gill netting captures predominately male fish, analysis of growth and condition data are restricted to mature male lake trout.

In 2017, a total of 274 Lake trout were tagged; 187 within Quabbin Reservoir and 87 within Wachusett Reservoir (Table 2). Within Quabbin Reservoir, 29 of the 187 fish captured were recaptures which displayed a modal recapture interval of 3 years and a maximum of 11 years. Among the 174 fish recaptured in Quabbin since 2007, the annual growth rate expressed as a percentage of body length is 1.3% which equates to approximately 6.2mm per year. Within Wachusett Reservoir, 9 of the 87 Lake trout were recaptures; 6 originally tagged in 2015 and 3 in 2016. Among the 18 fish recaptured in Wachusett since 2015, the annual growth rate expressed as a percentage of body length is 1.5% which equates to approximately 8.8mm per year. However, these statistics must be interpreted with caution due to the limited number of recaptured fish encountered since the inception of the project. As more recaptures are encountered in successive years this estimate is likely to change.

Within Quabbin Reservoir, relative condition has increased since 2014, and mean length at catch rose significantly relative to 2016. However, these metrics appear to be trending downward over the entire period of record (Figs 1 and 2). Intradecadal oscillations in these measures are likely a function of changes in forage fish abundance as one qualitative measure of forage fish decreased by 10 fold between 2009 and 2011. Similar patterns observed in the number of land locked salmon submitted to the sportfishing awards program suggest this species responds to forage fish abundance as well. Within Wachusett Reservoir, Lake Trout condition remained stable relative to 2016 although mean length at catch declined (Figs 3 and 4). Unlike Quabbin where large numbers of fish congregate on Windsor dam and Goodnough Dike to spawn, spawning areas in Wachusett Reservoir seem to be smaller in size, fewer in number, and unequally distributed in space. Sampling crews have yet to find spawning areas that produce consistent numbers of fish each night in Wachusett Reservoir.

Quabbin Salmon Marking:

Each spring approximately 10000 salmon smolts are reared at the Palmer hatchery and stocked into Quabbin Reservoir by MassWildlife staff. In past analyses these fish reach 15 in (legal size) within 2 to 4 years after stocking and are a popular recreational species in the Quabbin Reservoir. Mature salmon are also known to reproduce successfully in tributary and shoal habitats in the reservoir. Juvenile salmon spend 1 to 3 years rearing in tributary habitats before out-migrating as smolts in unknown numbers. Thus, landlocked salmon entering the creel are an unknown ratio of hatchery reared and naturally produced fish. In spring 2016, the fisheries section began a project marking (adipose fin clip) all salmon stocked into the reservoir. Once all non-marked hatchery reared salmon leave the population creel data will be collected to determine the ratio of tagged to untagged fish in the creel. These data will inform hatchery personnel about the relative contribution of stocked fish to the creel which over time could inform future stocking actions and provide anglers a means to identify naturally produced fish. Otoliths of legal fish were obtained from anglers at 2 Quabbin boat liveries in the summer of 2017 to update our understanding of the age that salmon enter the creel and the maximum age of fish in the population. These data will be used to determine when the majority of non-tagged hatchery raised fish have left the population and thus when to initiate survey efforts.

Fisheries Database:

This year roughly 350 historic stream and lake surveys spanning from 1940 to the later 1980's were added to the fisheries database. These samples were either contained in old basin reports or were stored in lake and pond paper files and include Lake Trout sampling data from 1964 to 1996. Prior to their inclusion into the database, these records existed only on paper. As such, this information was not searchable or considered when assessing the fisheries resources of a particular lake or stream. These efforts now permit biologists to review data collected over a roughly 80 year time span when assessing the ecological character of a waterbody. Furthermore, biologists are able to compare the fish community of a particular lake or stream over long time periods. Since our efforts to digitize and catalog all our historic sampling data began in the winter of 2014, close to 4000 samples have been entered into an electronic database, scanned, and can be rapidly accessed by biologists from their computer.

Fisheries GIS Layers:

As modern fisheries surveys are conducted and historic surveys are converted to electronic form these data are entered into the fisheries database. Several GIS products are created from these data and each time new information is added to the fisheries database these GIS layers must be updated. Following the addition of samples into the fisheries database, R scripts are used to create a table of summary data for each sampling point (Appendix B, *see electronic version*). Such information includes, species, abundances, sample type, date, presence of coldwater fish, hyperlinks to raw datasheets and scanned historical documents and other information that biologists can use to rapidly access the character of a stream or waterbody. These data are exported from the database and imported as points into ArcGIS where they are cross-referenced with National Hydrography dataset (NHD) stream linework and waterbody polygons that have been sampled by MassWildlife in the past. Using the unique identifier of each stream and waterbody, the sampling point data and stream and waterbody line and polygon data are rectified. Errors are identified as instances where the unique identifier of a point is not in agreement with

the unique identifier of the closest line or polygon to that point. Via this process, errors in coordinates or identifiers are found and resolved, and streams and waterbodies that have not been previously sampled are added to the hydrography dataset. Finally, sampling points are snapped to stream lines and polygons, and snapped coordinates are exported from ArcGIS and imported back to the fisheries database via R scripts (Appendix B, *see electronic version*). Once the fisheries data are plotted, and errors are fixed, value-added spatial data layers and products such as the coldwater fisheries resource layer may be easily generated by subsetting these master layers using simple queries in ArcGIS.

Modern GIS analyses require accurate boundaries from which to calculate physical habitat metrics. Watershed boundaries of lotic systems are typically delineated using digital elevation models. While this approach can be used for lentic systems as well, anthropogenic effects proximal to the shorelines may also be important in structuring fish communities in these systems. To capture shoreline habitat data effectively, accurate shorelines are paramount. Current shorelines contained within the National hydrography dataset were delineated from topographic maps and are not precise. Thus, to obtain the most precise data from nearshore areas, efforts to redeliniate lentic shorelines was initiated. The fisheries database was queried and all lakes and ponds that were sampled by MassWildlife personnel were identified. These 611 ponds were prioritized for delineation and all have been redeliniated and stored within an updated lake and pond shore GIS file.

Efforts began in 2017 to create GIS models which delineate the upstream watersheds for all fisheries sampling points with appropriate fisheries data. To date, watersheds have been delineated and reviewed for 5281 sampling points including both lotic and lentic waterbodies encompassing samples conducted up through 2015. Land use characteristics and impervious cover have been clipped and summarized from these areas as well.

Smaller projects

Synthesis of long term Lake Trout Data

Fall Lake Trout gill netting and tag return data collected between 1964 and 1996 was entered into electronic form and trends in growth, length at capture, and condition were investigated. Results and analysis were synthesized into a scientific publication and submitted to Northeast Naturalist for publication.

Spawning smelt surveys Quabbin

During April 2018, 10 tributaries to the Quabbin Reservoir were investigated for evidence of Rainbow Smelt reproduction. These streams were indicated in previous reports to receive Rainbow Smelt spawning runs in the 1980's. Water quality data were collected above the first riffle of each stream and areas between the deepest wadeable sections of the creek up to the second riffle were searched for egg deposition.

In total, egg deposition was observed in 4 streams, 3 on the west side of the Prescott peninsula (Egypt, Gibbs, and Underhill Brooks) and 1 on the west arm of the reservoir (Gulf Brook). Egg mats were light to moderate in density and were comprised of viable and nonviable eggs. Stream pH of Prescott peninsula streams was generally higher than West arm tributaries.

Public version fisheries GIS layers

Modified data import and export scripts to create a light version of the fisheries GIS layers for release on MASSGIS (Appendix C, *see electronic version*). The layers await internal review.

Ecological effects of seasonal water level drawdowns in Massachusetts lakes and ponds

MassWildlife continues to support research conducted by the University of Massachusettes and graduate student Jason Carmignani concerning the effects of seasonal water level drawdowns on lakes and ponds throughout the state. In 2017, Masswildlife assisted these efforts by sampling Lake Buel and Stockbridge Bowl in the spring and fall. Boat electrofishing, beach seining, and minnow traps were used to collect fish and lengths and weights were collected. Furthermore, as a member of Jason Carmignani's thesis committee I have reviewed 2 manuscripts resulting from his research and met to discuss methods and statistics pertaining to the direction and scope of his work.

Fisheries seasonal technicians

I hired and managed 2 seasonal fisheries technicians for the summer who were extremely beneficial to the fisheries section. The technician's primary duties were to assist biologists sampling fish in the field, and enter these and other historic data into our database. The technicians were particularly helpful with lake/pond and river sampling as it is preferable to have a crew of 4 while boat shocking and even more when working in rivers. Within a section as small as fisheries, scheduling can become difficult as multiple projects are being conducted concurrently. The technicians allow additional flexibility in scheduling and permit biologists to complete their sampling within the necessary timeframes. Furthermore, since the section began hiring seasonal technicians in 2016 we have collectively entered into electronic form and organized almost all of the quantitative and qualitative data collected by the section since 1900, a task that would not have been possible without the additional help.

Table 1: Waterbodies surveyed by fisheries personnel in fiscal year 2017 including survey date, town, and district.

Waterbody Name	Palis	Date Sampled	Town	District
West Waushacum Pond	81153	7/6/2017	Sterling	Central
Indian Lake	51073	7/10/2017	Worcester	Central
Long Pond	36082	7/11/2017	Rutland	Central
Long Pond	82072	7/12/2017	Littleton	North East
Bare Hill Pond	81007	7/14/2017	Harvard	Central
Rohunta Lake [M.b.]	35070	7/18/2017	Athol, New Salem, Orange	Conn. Valley
Rohunta Lake [N.b.]	35106	7/18/2017	Athol, Orange	Conn. Valley
Wampanoag Lake	81151	8/17/2017	Ashburnham, Gardner	Central
Buel Lake	21014	8/22/2017	Monterey, New Marlborough	Western
Stockbridge Bowl	21105	8/24/2017	Stockbridge	Western
Cranberry Pond	34018	10/4/2017	Sunderland	Conn. Valley
Russell Pond	32061	11/9/2017	Russell	Western
Lake Chauncy	82017	5/10/2018	Northboro	Central
Eddy Pond	51043	5/14/2018	Auburn	Central
Buel Lake	21014	5/16/2018	Monterey, New Marlborough	Western
Stockbridge Bowl	21105	5/17/2018	Stockbridge	Western
Watershops Pond	34099	5/21/2018	Springfield	Conn. Valley
East Monponsett Pond	62218	5/29/2018	Halifax	South East
West Monponsett Pond	62119	5/30/2018	Halifax	South East
Lake Quinsigamond [S.B.]	51125	5/31/2018	Shrewsbury/Worcester	Central
Assabet River Reservoir 1	82004	6/5/2018	Westboro	Central
East Brimfield Lake	41014	6/6/2018	Brimfield	Conn. Valley
Long Pond	41062	6/7/2018	Strubridge/Brimfield	Conn. Valley
Webster Lake	42064	6/8/2018	Webster	Central
Lake Lashaway	36079	6/12/2018	East Brookfield/North Brookfield	Central
Moosehorn Pond	36097	6/13/2018	Hubbardston	Central
Tully Lake	35111	6/14/2018	Royalston	Central
Little Alum Pond	41029	6/18/2018	Brimfield	Conn. Valley
knopps Pond/Lost Lake	81063	6/19/2018	Groton	North East
Congomond Lakes	32021	6/22/2018	Southwick	Conn. Valley
Buffamville Lake	42005	6/25/2018	Oxford	Central

Table 2: Number of Lake Trout tagged and recaptured Lake Trout from Quabbin and Wachusett Reservoirs since PIT tags were implemented in 2006.

	Quabbin Reservoir		Wachusett Reservoir	
Year	Tagged	Recaptured	Tagged	Recaptured
2006	279	NA		
2007	57	2		
2008	109	6		
2009	191	13		
2010	177	30		
2011	6	0		
2012	0	0		
2013	254	16		
2014	290	14	110	NA
2015	398	31	161	6
2016	277	7	67	3
2017	158	29	78	9
Total	**2225**	**148**	**425**	**18**

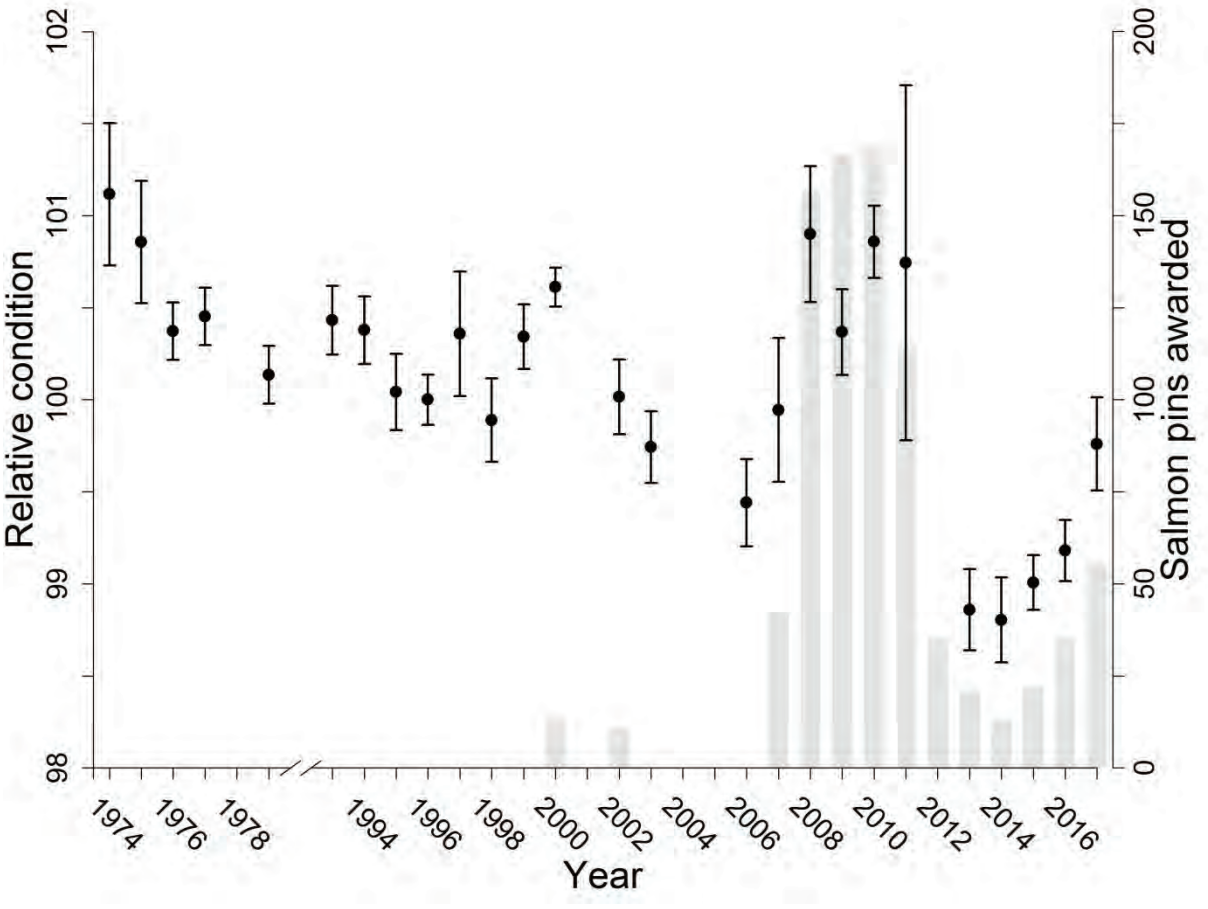


Figure 1: Relative condition factor with 95% confidence intervals from mature male Lake Trout captured from Quabbin Reservoir between 1974 and 2017. Shaded bars plotted on the secondary y axis depict the number of landlocked salmon submitted to the Freshwater Sportfishing Awards Program that were caught from Quabbin Reservoir since 2000.

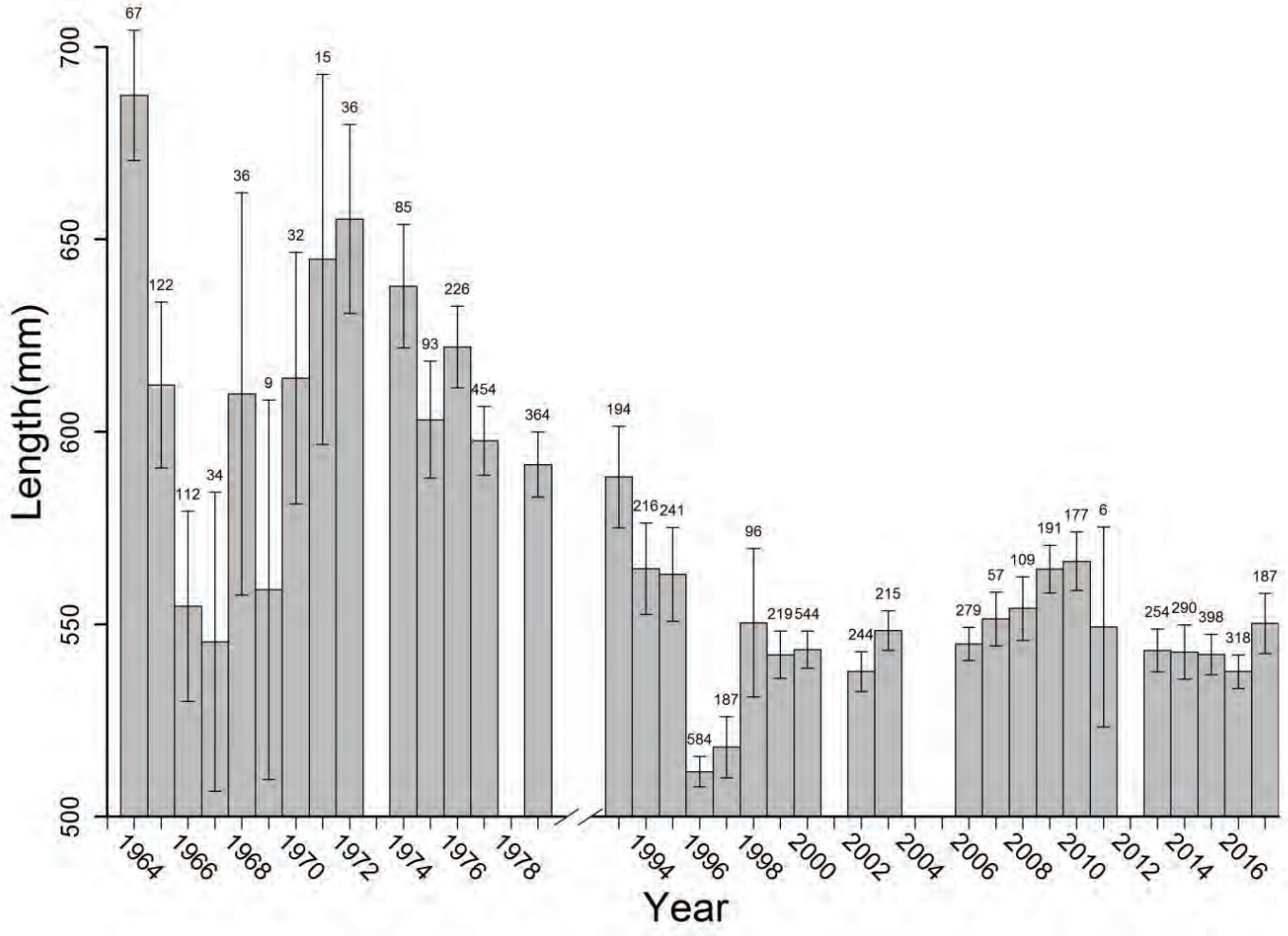


Figure 2: Length at catch with 95% confidence intervals and sample sizes for mature male Lake Trout captured in Quabbin Reservoir between 1964 and 2017.

Photo by Bill Byrne/MassWildlife

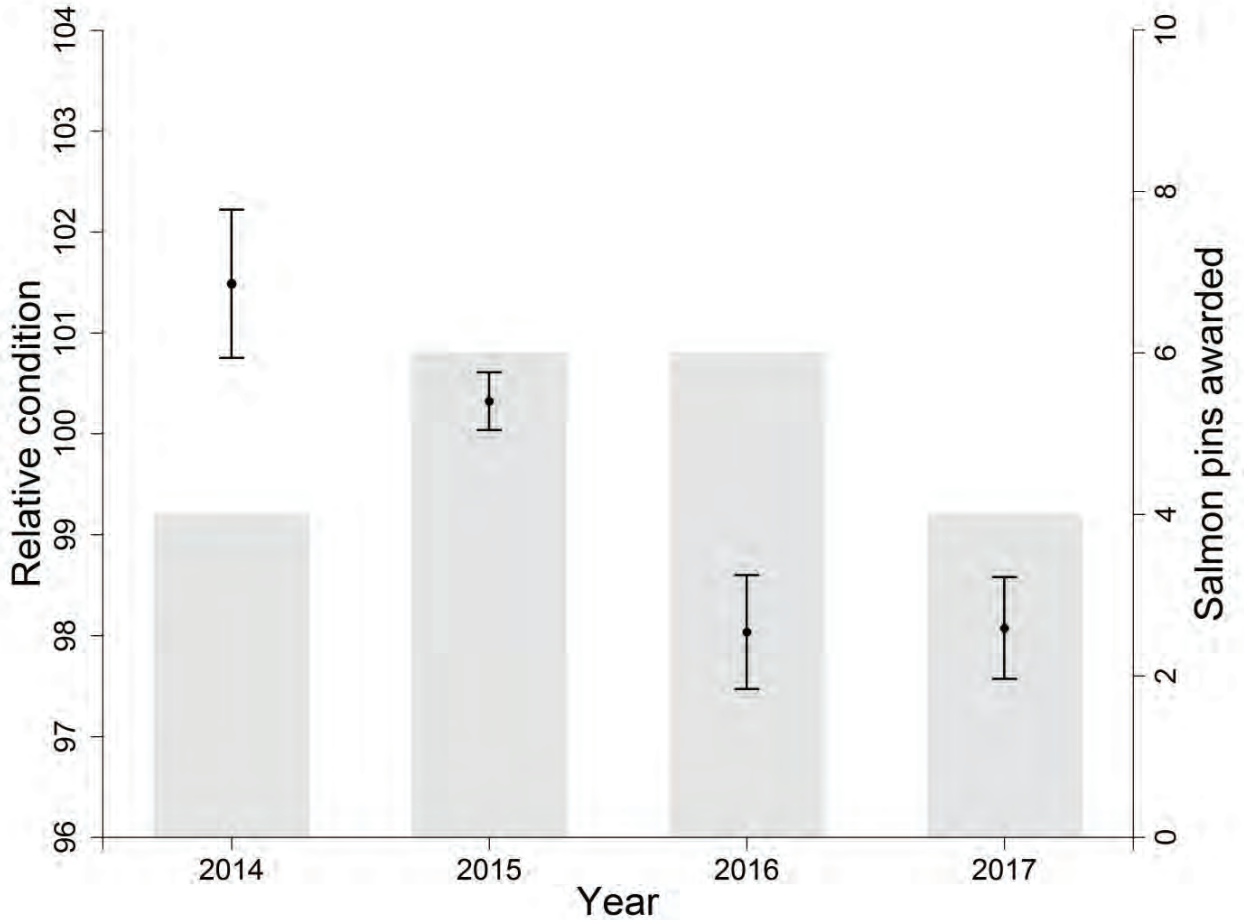


Figure 3: Relative condition factor with 95% confidence intervals from mature male Lake Trout captured from Wachusett Reservoir between 2014 and 2017. Shaded bars plotted on the secondary y axis depict the number of landlocked salmon submitted to the Freshwater Sportfishing Awards Program over the same time period.

Photo by Brian Keleher/MassWildlife

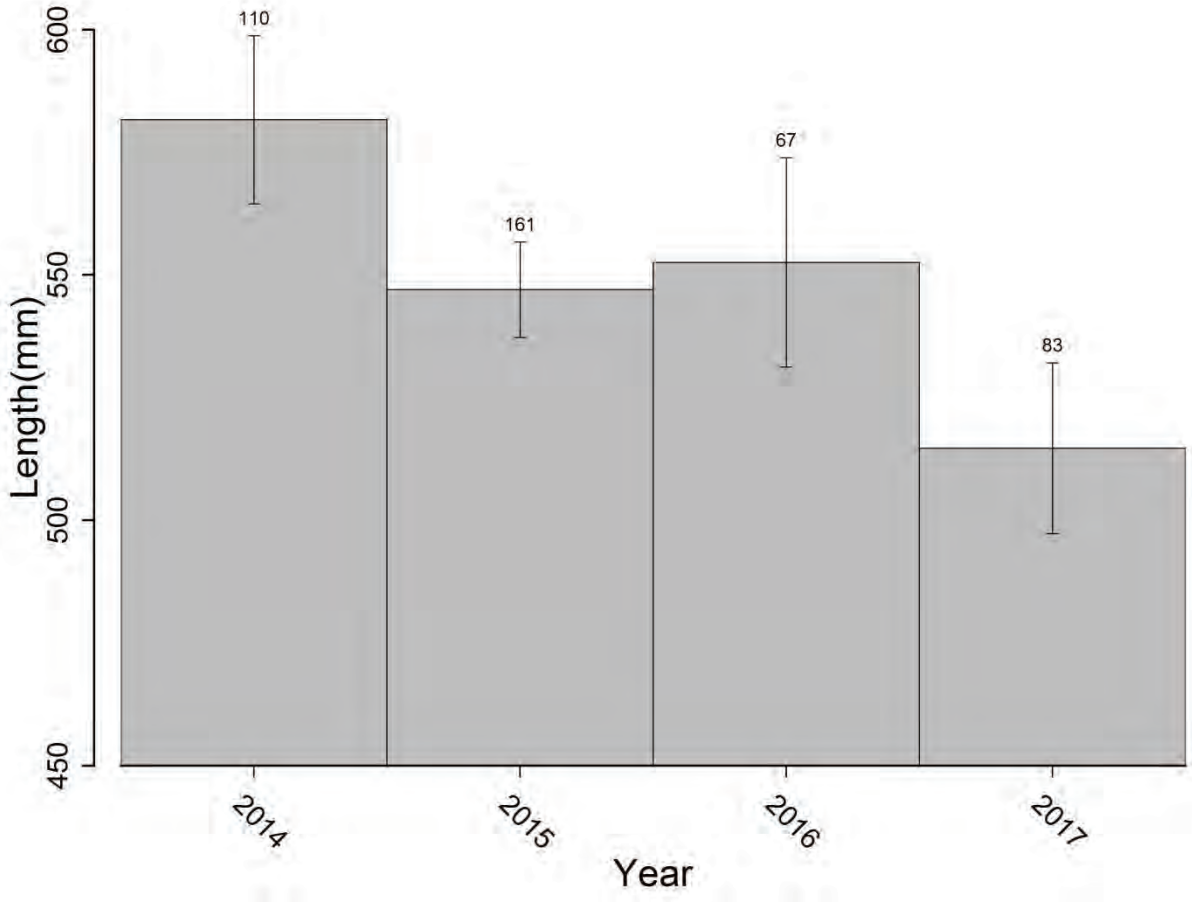


Figure 4: Length at catch with 95% confidence intervals and sample sizes for mature male Lake Trout captured in Wachusett Reservoir between 2014 and 2017.

II. Fisheries GIS - David Szczebak, Project Leader

Activities included in this project in FY 18 concentrated primarily on continued development of the stocked waters application, revision of pond maps and narratives, and development of a catch and release datalayer.

1. Stocked Waters Application

In FY2018 there was a significant effort to improve our trout stocking web application. The internal component, an online Google-based database, was designed to house annual stocking schedules, orders, and allocations in one repository. Information from the database automatically populates the public stocking list accessible on the Division's website. The resulting system has eliminated much of the manually-generated orders, lists, and emails that were previously used to generate the same stocking orders and schedules. Staff using the application at the five district offices and four hatcheries reported a positive experience using the database, and after we made some improvements to the queries in the Google sheets, quicker and smoother data entry and filtering of data.

Improvements to the stocking application in FY2018 included adding an additional spatial layer depicting the totality of stocked waters in the state. In order to develop this statewide stocked-waters datalayer, the district fisheries biologists were consulted to extensively review the list of streams and ponds as well as the specific stocking locations.

The web application on www.masswildlife.org/trout continued to garner very positive reaction from the public. For the period of spring trout stocking, from March 6, 2018 - June 30, 2018, the stocking application web pages received a total of 248,302 unique page views, making it the most-visited web page in the Department during that period. Compared to spring, 2017, the online map and list of stocking locations saw a 21% increase in visitors. The rate of increase indicates a positive and growing awareness and appreciation of the application by the public.

2. Pond Map and Narrative Revision

In FY2018, the Fisheries section conducted more bathymetric surveys of lakes and ponds, and updated the pond maps available to the public on the MassWildlife website. There was a particular effort to map ponds in Southeast and Northeast Massachusetts. Pond map fact sheets, which describe fisheries resources, aquatic habitat, and recreational access, were updated based on the most recent sampling and information provided by the MassWildlife District Offices. New pond maps begun in FY2017 and accompanying write-ups were posted to the MassWildlife web site. A total of 49 new pond maps were posted to the website in FY2018 (Table 1).

Bathymetric surveys were conducted on an additional 41 ponds during fall, 2017, through spring, 2018 (Table 2). These ponds will be made available to the public once maps and write-ups are complete.

In addition to the pond maps and fact sheets available to the public, we also updated the GIS layer of bathymetry collected during our surveys. This was made available to the public as both an interactive and downloadable GIS layer. The downloadable bathymetric contour layer allows users to display the data at 5-foot contour intervals, and is available from MassGIS at:

http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/dfwbathy.html

The interactive bathymetry layer is called 'Inland Waters Bathymetry' and is available through the MassGIS OLIVER application at:

http://maps.massgis.state.ma.us/map_ol/oliver.php

3. Catch and release Area Maps

In FY2018 the fisheries section began development of catch and release area maps and fact sheets, similar to the pond maps that the section produces. Every catch and release area will have a detailed map depicting the starting and ending points of the catch and release section, access areas and the surrounding landscape. The catch and release fact sheets will describe the fishery, habitat, and access points for each section.

Currently, there exists a list on the MassWildlife website that has a brief, one or two line description of the catch and release area. This effort is intended to provide anglers with updated information on the catch and release areas and where to access them. District

biologists identified access areas and other pertinent information. The maps and fact sheets have received extensive review and should be ready for public release in the fall/winter of 2018.

IV. Anadromous Fish Investigations - Caleb Slater, Ph.D., Project Leader

1. General

In FY 18, MassWildlife hired three 6-month seasonal workers to conduct the Index Site Fish Population assessment work in Connecticut River tributaries and staff the West Springfield fishway on the Westfield River. This work includes stream samples at 50 sites on 45 streams that have been sampled annually as part of the Atlantic Salmon restoration program for the last 20 years-consequentially making these sites the longest continuously sampled streams in the Commonwealth. This electrofishing crew is also used to fill data gaps by sampling previously un-sampled streams or re-sampling historic (> 20 years old) sites and to aide other Project Leaders or District Biologists by conducting surveys as requested or by combining with other crews for large sites or boat or barge shocking. An additional three seasonal workers were hired for 3-months to staff the Essex fishway on the Merrimack River in Lawrence, MA. Holyoke Gas & Electric, as directed by the conditions of their FERC hydroelectric license, hired seasonal employees to staff the Holyoke fishway and Firstlight Power monitored fish passage at the Turners Falls fishways. The Project Leader supervised these activities.

The U.S. Fish and Wildlife Service withdrew its support and resources from the Connecticut River Atlantic Salmon restoration program in 2013. No Atlantic salmon fry have been produced at the Roger Reed State Fish Hatchery in Palmer, and no Atlantic salmon fry have been stocked since 2013. As a result the number of Atlantic salmon fry collected during index site sampling have declined to near zero over the last several years.

During FY 18, the Project Leader was actively involved in Federal Energy Regulatory Commission (FERC) Hydroelectric proceedings concerning:

- Application for a license at the Pepperell Paper dam on the Nashua River in Pepperell
- Application for a new license at the Watershops Pond Project on the Mill River in Springfield, MA.
- Evaluation of new downstream fish passage protections at the Holyoke Hydroelectric Project on the Connecticut River in Holyoke
- Application for relicensing of the Holyoke City #1 Project on the Holyoke Canal in Holyoke
- Application for relicensing of the Holyoke City #2 Project on the Holyoke Canal in Holyoke
- Application for relicensing of the Holyoke City #3 Project on the Holyoke Canal in Holyoke
- Application for relicensing of the Northfield Mountain Pumped Storage Project on the Connecticut River
- Application for relicensing of the Turners Falls Project on the Connecticut River
- Application for relicensing of the Bear Swamp Pumped storage facility on the Deerfield River
- Application for relicensing of the Fife Brook project on the Deerfield River
- Application for relicensing of the Riverdale Project on the Blackstone River
- Application for relicensing of the Tupperware Project on the Blackstone River
- Application for a preliminary permit for the Turners Falls Project, on the Turners Falls Power Canal

The Project Leader worked with the Massachusetts Department of Energy Resources, commenting on the applications of numerous hydroelectric projects seeking to qualify for “Low Impact Hydroelectric Certification” and/or “Green Energy” credits in Massachusetts.

- Lowell Project, Merrimack River
- Red Bridge Project, Chicopee River
- Gardners Falls Project, Deerfield River
- Holyoke Project, Connecticut River
- Cresticon Project, Millers River
- Collins Project, Chicopee River.

During FY 18 the Project Leader assisted in the Bathymetry project by collecting depth data on 24 ponds, mainly in the North East District, and vertical Temperature/Dissolved Oxygen profiles in 20 ponds.

In FY18 the project leader participated in MassWildlife’s controlled burn program by attending the annual fireline refresher course and by participating in three

controlled burns on MassWildlife lands.

In FY18 the project leader spent three days working the MassWildlife deer check station on Martha's Vineyard during the first week of the shotgun deer season.

In FY18 the project leader was responsible for fisheries environmental review which involved review of MADOT projects, NPDES permits, NOIs from local Con Coms, MEAP projects and coordination of comments with the NH&ES section.

In FY18 the Project leader continued to serve as the Fisheries representative to MassWildlife's land acquisition program, attending two rounds of parcel meetings and ranking parcels for purchase priority.

In FY18 the project leader supervised the permitting and construction activities performed by StanTec and SumCO for the successful completion of the Hamant Brook Restoration and Dam Removal Project.

In FY18 the project leader assumed the role of coordinator for all activities related to repair and removal of dams on MassWildlife lands. MassWildlife has identified 35 dams on its properties, including 10 rated as Significant Hazard by the MA office of Dam Safety. The estimated cost to properly repair/remove and operate these dams is $12.4 Million. $1.15 million has been allocated for dam repair/removal projects in FY19.

2. Connecticut River

The Project Leader actively participated in the Connecticut River Atlantic Salmon Commission (CRASC), and continued as the chair of the CRASC Technical Committee. Many telephone, electronic, and written requests for information were also answered by the Project Leader. The FERC Relicensing of 5 hydroelectric projects on the Connecticut River (Northfield MT, Turners Falls, Vernon, Bellow Falls, and Wilder) continued this year. This is a 5 year process that will require close attention.

Because 2018 fish passage operations are ongoing at this time, this report summarizes the 2017 calendar year fish passage activities.

2.1 Holyoke

The City of Holyoke (Holyoke Gas and Electric Co. HG&E) bought the Holyoke Hydroelectric project from Northeast Utilities in 2002. The Project Leader has been involved in ongoing negations with the new owner to settle the outstanding issues and finalize the FERC license for the project (awarded in 2001). Holyoke Gas and Electric Co., as directed by the conditions of their new FERC hydroelectric license, hired seasonal employees for the Holyoke fishway in spring 2013. The Project Leader supervised their activities.

Upstream fish passage operations were conducted April through July, 2017. Early April, the nominal beginning of the fish passage season, was characterized by cold water temperatures and high flows. As a result, fish passage operations did not commence until April 24 when water temperature was 7.4°C. Initially, passage monitoring occurred from 0900 – 1500 h. On April 29, water temperature averaged 10.7°C, and 3,624 American Shad were passed, triggering fish passage operations from 0800 – 1800 h per standard procedures. Daily operations continued for anadromous fish passage through July 14. Operations were then conducted four times per day, Monday through Friday from July 17 through November 15 (with exceptions) for Shortnose Sturgeon collection Anadromous fish species were identified and counted.

The Holyoke fish passage facility operated for 71 days during in the spring season passing a total of 560,242 anadromous fish (Appendix A, Table 1, *see electronic version*). 85 Shortnose Sturgeon were lifted during 2017. The number of days that passage was greater than 1% of the seasonal total was considerably less than 71. The number of days that passage is greater than 1% of the seasonal total, and the percentage of the total run that these days comprise, is a measure the temporal distribution of the run. The "over-1%-daily-passage" totals were: American Shad, 91% of 536,670 in 26 days; Blueback Herring, 94% of 826 in 13 days; Sea Lamprey, 91% of 19,575 in 18 days; Striped Bass, 88% of 338 in 26 days; Gizzard Shad, 87% of 738 in 24 days (Appendix A, Table 1, *see electronic version*).

2.1.1 Atlantic Salmon

10 Atlantic Salmon were counted during the spring fish passage season and one in the fall at the Holyoke fishlift (Table 1). 2017 passage (3) was 3% of the record

passage of 1992, 7% of the previous five year mean, and 5% of the previous ten year mean (Appendix A, Table 2, *see electronic version*). All salmon were released and allowed to continue their upstream migration. No salmon were radiotagged in 2017.

2.1.2 American Shad

536,670 American shad were passed upstream. This was 75% of the record high passage of 1992. 2017 passage was 130% of the previous five year mean, and 183% of the previous ten year mean (Appendix A, Table 2, *see electronic version*). The total number of shad lifted in 2017, including shad transferred to trucks for transport (3,547) and sacrificed for biological sampling and agency studies (265), was 540,482. Examining the cumulative percent of shad passed at Holyoke, 50% of fish passed this project on the 29th day of passage, May 22 (Appendix A, Table 3, *see electronic version*). A total of 1,054 American shad were sampled for biological data on 46 days from 26 April through 25 June. Fork length, weight, sex, and scale samples were collected from all individuals. This represents 0.2% of the total American shad passed for the year and between 0.15% and 20% of the daily shad passage at the facility. The weighted percentage of the run sampled (the total number of fish passed on days of sampling expressed as a percentage of the entire run) was 98%. The weighted sex ratio of American Shad lifted at the Holyoke facility in 2017 was 58% males and 42% females (Appendix A, Table 4, *see electronic version*).

3,547 shad were trapped and trucked for various restoration efforts (Appendix A, Table 5, *see electronic version*). 749 of these shad were trucked to the USFWS Nashua Fish Hatchery for spawning where 5,064,948 fry were produced. 4,191,054, fry were stocked in Merrimack River, 641,325 fry were released into the Nashua River, and 232,569 fry were released into the Charles River. 584 shad were trucked to the USFWS North Attleboro Fish Hatchery for spawning where 1,206,674 fry were produced. 583,364 fry were released into the Pawcatuck River, RI, and 623,310 fry were released into the Pawtuxet River, RI.

2.1.3 Shortnose Sturgeon

Eighty-five individual Shortnose Sturgeon were collected from the fish lifts in 2017 (Appendix A, Table 1, *see electronic version*). All sturgeon, except for two mortalities, were processed and released to the exit flume and allowed to continue their migration upstream of Holyoke Dam. Five of those were also tagged with a surgically implanted radio transmitter by Kleinschmidt Associates and fish lift monitoring staff before release per the post-construction sturgeon monitoring plan. The majority of Shortnose Sturgeon used the spillway fish lift (N = 67, 79%). One (1%) was known to have used the tailrace fish lift, and the remaining 17 (20%) were unknown.

There were two incidental mortalities within the fish lift system, which were observed by the HCC counting personnel during the daily operations of the lift on August 1 and October 12. In the first incident (SNS2017-76), the spillway fish lift hopper was found not to be seated fully into its basin. That coupled with the close (approximately six inch) separation between the crowder and hopper appeared to have created a condition that prevented the fish's ability to escape before being pinned by the lift tower gate. The cause of the second incident (SNS2017-85) could not be identified. Details were included in the Incidental Take Permit report. Following consultation with NMFS after the SNS2017-76 mortality event, HG&E modified the fish lift structure and procedures for the remainder of the season. Debris was removed from the hopper basin so that it seated properly. Four-inch square tube posts were attached to either side of the tower gate so that its bottom edge did not contact the concrete channel bottom, eliminating all but the area of the posts as potential crush points. To fill the approximately 10.75" space from the bottom edge of the tower gate and channel bottom and startle fish from under the gate, a ¼" x 12" tall soft rubber skirt was added to the bottom of the tower gate on the downstream side. Finally, to prevent trapping of fish in the small space between the crowder and hopper, the crowder was taken off line for the duration of the season.

2.1.4 American Eel

Eel ramps were deployed in the tailrace and spillway fish lift entrances on May 24 and in the upper stilling basin on June 6. The South Hadley eel ramp was deployed June 19. All eel ramps were operated until November 9.

Juvenile eel passage totaled 17,037 in 2017, the fifth highest annual total recorded at Holyoke Dam since 2003 when specific eel collection and upstream passage

efforts began. The South Hadley ramp contributed 35.4% of the annual total collections and 64.6% were collected from the ramps in the Holyoke fish lift structures with nearly equal distribution between the tailrace fish lift entrance ramp (31.8%) and the stilling basin ramp (32.8%). The spillway entrance ramp contributed only 0.1% of the annual total. (Appendix A, Table 6, *see electronic version*).

2.1.4 Other Anadromous Fish Species

Blueback Herring passage in 2017 (875) was 198% of the previous five-year mean and 333% of the previous ten year mean (Appendix A, Table 2, *see electronic version*).

Sea Lamprey passage in 2016 (21,526) was 22% of the record passage of in 1998 and was 93% of the previous five-year mean and 74% of the previous ten year mean (Appendix A, Table 2, *see electronic version*).

Gizzard Shad passage in 2016 was 738. This was 164% of the previous five-year mean and 222% of the previous 10 year mean (Appendix A, Table 2, *see electronic version*).

2.1.5 Resident Fish

A total of 2,207 fish representing 22 non-anadromous resident species were counted using the fish lifts from April 26 – July 14.

2.2 Turners Falls

The fishladders at Turners Falls were operated for a total of 71 days from April 28 through July 7, 2017. Operational problems were reviewed as needed on an ongoing basis by agency personnel (Massachusetts Division of Fisheries and Wildlife, and United States Fish and Wildlife Service), and by the dam owner (Firstlight Power).

Upstream fish passage counts were made at the Spillway, Gatehouse, and Cabot fish ladders by review of recorded passage. Digital recordings were reviewed by employees of Firstlight Power. All ladders were monitored twenty-four hours each day unless technical problems occurred. All fish ladders remained open for passage twenty-four hours each day.

American Shad and Atlantic Salmon were identified and enumerated at the Spillway, Gatehouse and Cabot ladders, Sea Lamprey were counted only at the Gatehouse (Appendix A, Table 7, *see electronic version*).

2.2.1 American Shad

The number of shad passing the Gatehouse fish ladder in 2017 (48,727) was 81% of the maximum passage of 1992 (Appendix A, Table 7 and 8, *see electronic version*), 113% of the previous 5 year mean and 188% of the previous 10 year mean.

The number of shad passing the Spillway fish ladder in 2017 (16,741) was 40% of the maximum passage of 2015 (Appendix A, Table 7 and 8, *see electronic version*), 78% of the previous 5 year mean and 146% of the previous 10 year mean.

The number of shad passing the Cabot fish ladder in 2017 (43,269) was 46% of the maximum passage of 1992 (Appendix A, Table 7 and 8, *see electronic version*), 98% of the previous 5 year mean and 136% of the previous 10 year mean.

Only 9% of the shad lifted at Holyoke (536,670) passed the Gatehouse observation window, well below the restoration goal of 50%.

2.2.2 Other Anadromous Fish Species

15,128 Sea Lamprey passed the gatehouse fishway in 2017. This represents 47% of the maximum passage of 2008 (Appendix A, Table 7 and 8, *see electronic version*), 127% of the previous 5 year mean and 86% of the previous 10 year mean.

3. Westfield River

The West Springfield fish passage facility operated for 88 days in the spring of 2017.

3.1 Anadromous fish

The West Springfield fish passage facility operated for 88 days in the spring of 2017. The number of days that passage was greater than 1% of the seasonal total was considerably less than 100. The number of days that passage is greater than 1% of the seasonal total, and the

percentage of the total run that these days comprise, is a measure the temporal distribution of the run. The "over-1%-daily-passage" totals were: American shad, 85 % of 6,004 in 20 days; sea lamprey, 93% of 262 in 23 days (Appendix A, Table 9, *see electronic version*).

During the spring/summer season 5 Atlantic salmon were trapped transported by Division personnel to the East Branch of the Westfield River upstream of the Knightville Dam.

A total of 6,004 American Shad; 5 Atlantic salmon; 262 Sea Lamprey; 1 Striped Bass; 5 Blueback Herring; and 0 Gizzard Shad were passed upstream in spring/summer 2017 (Table 9). The 2017 shad passage was 58% of the record high of 10,373 in 2012 (Appendix A, Table 10, *see electronic version*).

3.2 Non-anadromous fish

White sucker, brook trout, brown trout, rainbow trout, tiger trout, and smallmouth bass were documented passing upstream through the West Springfield fish passage facility in 2017 (Appendix A, Table 9, *see electronic version*).

4. Merrimack River

4.1 Essex Dam

The Essex Dam fish elevator operated for 89 days between 17 April and 14 July 2017. For the fall season the fishway was operated from 15 September through 1 November. During the spring migration period the Essex Dam fish elevator was operated seven days per week. Hours of operation were generally 8:00 a.m. to 4:00 p.m. throughout the season. During the fall four lifts were made per weekday.

Daily fish passage numbers for the 2017 fish passage season are summarized in Appendix A, Table 11, *see electronic version*. Annual fish passage numbers for the period of record (1982-2016) are summarized in Appendix A, Table 12, *see electronic version*.

4.1.1 Atlantic salmon:

Five adult Atlantic Salmon were lifted at the Essex fishlift during spring 2017 (Appendix A, Table 11, *see electronic version*). This was 15% of the record passage of 2011. Salmon returns were 11% of the previous 5 year mean, and 5% of the previous 10 year mean. No salmon were captured in the fall (Appendix A, Table 12, *see electronic version*).

4.1.2 American Shad:

The total number of shad lifted in 2017 (62,848) was 70% of the record passage (89,421) of 2015 (Appendix A, Table 11, *see electronic version*). 2017 shad passage was 126% of the previous five year mean (Appendix A, Table 12, *see electronic version*) and 186% of the previous ten year mean (Appendix A, Table 12, *see electronic version*). 246 shad were sampled for biological data collection on 4 days between May 18 and July 13. The sample was 67% female, and 47% were repeat spawners.

4.1.3 River Herring:

2017 passage was 91,617 this was 24% of the record high passage (417,240) of 2016 (Appendix A, Table 12, *see electronic version*). 2017 herring passage was 75% of the previous five year mean (Appendix A, Table 12, *see electronic version*) and 150% of the previous ten year mean (Appendix A, Table 12, *see electronic version*). 152 herring were sampled for biological data collection on 29 days between May 15 and May 22.

4.1.4 Other Anadromous Fish:

Total number of Sea Lamprey, Striped Bass, and Gizzard Shad passing through the Lawrence fishlift were 2,056, 2,060, and 0 respectively.

4.1.5 American Eel

An estimated 8,645 elvers were passed in the lift hopper and 17,691 passed the new permanent eelway at the dam for a total of 26,336.

4.2 Pawtucket Dam

Fish Lift

The Lowell Ladder was operated for a 10 week period from May 13 through July 15 per agreement with ENEL and the Merrimack Technical Committee. The SalmonSoft video system was used to record fish passage. Videos were reviewed with Windows Media player or VLC software (Appendix A, Table 13, *see electronic version*).

The estimated total number of American Shad passed at the Lowell lift in 2017 was 3,699 (Appendix A, Table 13, *see electronic version*).
The estimated total number of River Herring passed at the Lowell lift in 2017 was 3,541 (Appendix A, Table 13, *see electronic version*).

Fish Ladder
The Lowell Ladder was operated for a 10 week period from May 13 through July 15 per agreement with ENEL and the Merrimack Technical Committee. The SalmonSoft video system was used to record fish passage. Videos were reviewed with Windows Media player or VLC software. Appendix A, Table 13.

4.2.1 River Herring:

2,080 river herring were counted passing the ladder. We estimate the Lowell Project as a whole passed about 5,621 River Herring.

4.2.2 American Shad:

1,387 American Shad were counted passing the ladder. We estimate the Lowell Project as a whole passed about 5,086 American Shad.

This represents 8% of the shad passing through the Lawrence fishway this season (62,848). The management goal is 50%. Work continues to improve both the fish lift and ladder performance.

Table 19 lists the annual runs of anadromous fish counted at the facility from 1986, the first year of operation, through 2017.

4.2.3 Other Anadromous fish:

179 Sea Lamprey were counted passing the ladder. We estimate the Lowell Project as a whole passed about 333 Sea Lamprey.

6 sea-run Atlantic Salmon were seen at the Lowell fishlift. All sea-run Atlantic Salmon that entered the Lawrence fishlift were allowed to pass upstream as they are no longer required for broodstock.

Assorted riverine species have been noted but not counted.

5. Index Site Samples

Selected historically salmon stocked streams were sampled in 2017. 49 sites on 44 streams were sampled by personnel from the Massachusetts Division of Fisheries and Wildlife.

A single-pass technique utilizing a battery powered backpack shocker was employed on all streams sampled. All fish seen were captured. Fish were held in live cars after capture, identified to species, and measured for total length. Upon completion of subsequent 'work up', all fish were released back into the index site. Index sites were selected to be proportionately representative of the habitat types in each stream. To prevent over or under estimation due to disproportionate stocking, index sites were selected, whenever possible, near the middle of a stocking section. The area of stream sampled was obtained by measuring the length of the sampled section and multiplying by the mean width for that section.

Only 2 salmon were captured in 2017- this is to be expected as most salmon fry stocked in 2013 will have smolted and migrated to the ocean in 2015.

V. Hatchery/Trout Program – Ken Simmons, Ph.D., Project Leader

1. Trout Production and Stocking

The total number and pounds of each size category for each species of trout produced and stocked by the Division's five hatcheries in FY2018 are listed in Tables 1 and 2, respectively. Overall, a total of 520,035 brook trout, brown trout, rainbow trout and tiger trout with a combined weight of 455,497 pounds were stocked, which slightly exceeded the Division's annual trout production goal of 400,000 to 450,000 pounds. The production goal is based on the rearing capacity of each hatchery, which is determined by a combination of the quantity and quality of the water supply, rearing space and limits imposed by the National Pollution Discharge Elimination System permit that each hatchery is issued by the Massachusetts Department of Environmental Protection and the Federal Environmental Protection Agency. A second goal of the hatchery trout program is for 50% of the fish that are stocked to average 12 inches or longer (= 12+) in length. In FY2018, 75% (391,105

fish) of the fish that were stocked met or exceeded this size goal, including 293,357 rainbow trout, 49,968 brook trout, 46,813 brown trout and 967 tiger trout.

The Division divides trout stocking into fall and spring stocking seasons. During the FY2018 fall stocking season, which ran from late September through mid-October 2017, 99 ponds and lakes, and 11 rivers and streams in 80 cities and towns in the five Wildlife Districts were stocked with trout. A total of 61,831 14+ rainbow trout and 4,000 9+ brown trout with a total weight of 71,579 were stocked. 94% of the fish stocked in the fall season were in the 14+ size category.

In the spring stocking season, which ran from March through June 2018, a total of 454,204 trout with a combined weight of 383,918 pounds were stocked in 430 waterbodies (182 lakes and ponds and 248 rivers and streams) in 249 cities and towns. Some truly outstanding, trophy quality fish were stocked with 73% of the fish meeting or exceeding the 12+ size category. Of the 247,536 rainbow trout stocked, 231,526 (94%) were in the 12+ category or larger and 188,456 (79%) were 14+ and weighed an average of 1.2 pounds each. A total of 82,988 brook trout were stocked in spring FY2018, of which 49,968 (60%) were at least 2 ½ years old and in the 12+ or larger size category. Close to one thousand brook trout that averaged 2.4 pounds each were stocked. A total of 122,713 brown trout between 6 inches and 18+ inches were stocked with a total weight of 78,651 pounds. Thirty eight percent of these browns were 2 ½ years old and were 12+ inches or larger and averaged 1.1 pounds apiece. In addition, more than 1,200 brown trout were stocked that averaged 4.2 pounds apiece. 967 tiger trout produced at Sandwich Hatchery that averaged 14+ inches long with an average weight of 1.3 pounds per fish were also stocked (Tables 1 and 2, *see electronic version*). Tiger trout are a cross between a brown trout female and brook trout male and are called tiger trout because of their striking tiger-like stripes.

The Roger Reed Hatchery produced a total of 394,611 fertilized brown trout eggs and 776,322 fertilized brook trout eggs in FY2018. Sandwich Hatchery produced a total of 294,272 fertilized brown trout eggs, 294,272 fertilized brook trout eggs and 217,664 fertile tiger trout eggs (Table 3).

On March 2 and 3, 2018 a major winter storm (named Riley) struck Massachusetts. Coastal areas were particularly hard hit with near hurricane force winds, heavy rain and above normal tides. During the peak of the storm an area-wide power outage occurred on Cape Cod resulting in a power outage at Sandwich Hatchery. The hatchery's primary standby generator, which provides emergency power for the entire hatchery including the four wells and aeration system, was initially able to keep the hatchery fully functioning and all the fish alive as it was designed to do. However, after several hours the generator motor failed and could not be restarted by the generator technician called in to repair it. The generator, which is maintained in accordance to all manufacturer specifications, was fully tested prior to the storm as part of the hatchery's storm preparation protocols. As soon a problem was detected with the primary generator, staff requested the generator maintenance contractor provide a mobile generator capable of running the entire hatchery but due to the severity of the storm and the emergency conditions throughout the region it took several hours for it to be delivered and put into operation.

Failure of the generator resulted in a shutdown of 3 of the 4 wells that supply fresh water for the fish. Fortunately, a smaller secondary generator that can power the smallest hatchery well and a portion of the aeration system remained operable. The well that remained operating was able to provide enough fresh water for the fish in the hatch house, which was stocked with fry for future production, and for the fish in the raceways located downstream of the hatch house. However, because it was not possible to get fresh water to the raceways upstream of the hatch house, the water and oxygen levels in these raceways was rapidly depleted leading to the loss of 4,800 trout, including 1,780 14+ tiger trout that were scheduled for spring stocking. The loss of these fish, although unfortunate, represented less than 1% of the total number of fish scheduled for the spring stocking season resulting in only a minor impact on the Division's statewide stocking program. If it were not for the pre-storm preparations by staff and their subsequent extraordinary efforts throughout the course of the storm under some very difficult conditions, the loss of fish would have been substantially worse. The primary generator was repaired in the weeks after the storm and efforts are ongoing to secure funding for a second full service on-station generator to back-up the primary generator.

2. Landlocked Salmon Production and Stocking

The Roger Reed Hatchery produced a total of 16,736 landlocked Atlantic salmon in FY2018 (Table 3). 6,336 of these salmon that weighed a total of 342 pounds were transferred in September 2107 to the New Jersey Division of Fish and Wildlife Hackettstown Hatchery in exchange for northern pike fry and fingerlings. The remaining 10,400 salmon which averaged 9.1 inches and weighed a total of 2,453 pounds were stocked in Quabbin Reservoir in May 2018.

3. Northern Pike Stocking

In September 2017, northern pike yearlings that averaged 13 inches long were stocked in the Cheshire Reservoir system (835 fish) in Cheshire/Lanesboro and Quaboag Pond (1,032 fish) in Brookfield. In April 2018, the Cheshire Reservoir system was stocked with a total 16,126 northern pike fry that averaged 4 inches long. The pike were from the New Jersey Division of Fish and Wildlife's hatchery in Hackettstown.

		Number of Fish					
Species	Size Category (inches)	Bitzer	McLaughlin	Palmer	Sandwich	Sunderland	Total Number of Fish
Rainbow	6+	0	7510	0	0	0	7510
Trout	9+	8500	0	0	0	0	8500
	12+	0	0	0	0	43070	43070
	14+	25006	180150	0	35713	9418	250287
	Sub-total	**33506**	**187660**	**0**	**35713**	**52488**	**309367**
Brook	6 - 9	0	0	0	0	31700	31700
Trout	9+	0	0	520	0	800	1320
	12+	30000	0	0	11385	7727	49112
	14+	0	0	326	0	0	326
	18+	0	0	40	490	0	530
	Sub-total	**30000**	**0**	**886**	**11875**	**40227**	**82988**
Brown	6 - 9	22950	0	0	0	28950	51900
Trout	9+	4000	21500	500	0	2000	28000
	12+	18600	0	0	9775	17236	45611
	14+	0	0	0	0	0	0
	18+	0	0	254	948	0	1202
	Sub-total	**45550**	**21500**	**754**	**10723**	**48186**	**126713**
Tiger	14+	0	0	0	967	0	967
Trout	**Sub-total**	**0**	**0**	**0**	**967**	**0**	**967**
Total		109056	209160	1640	59278	140901	520035

Table 1. Number of trout produced at each of the Division's five fish hatcheries in FY2018 (fall 2017 and spring 2018).

Species	Size Category (inches)	Total Weight of Fish (Pounds) Bitzer	McLaughlin	Palmer	Sandwich	Sunderland	Total Pounds of Fish
Rainbow	6+	0	1840	0	0	1840	1840
trout	9+	4156	0	0	0	0	4156
	12+	0	0	0	0	31853	31853
	14+	25602	215333	0	38859	10587	290381
	Sub-total	**29758**	**217173**	**0**	**38859**	**42440**	**328230**
Brook	6 - 9	0	0	0	0	8550	8550
Trout	9+	0	0	436	0	179	615
	12+	20382	0	0	11023	4722	36127
	14+	0	0	817	0	0	817
	18+	0	0	182	1062	0	1244
	Sub-total	**20382**	**0**	**1435**	**12085**	**13451**	**47353**
Brown	6 - 9	5313	0	0	0	6864	12177
Trout	9+	2010	7942	380	0	615	10947
	12+	18563	0	0	12054	19875	50492
	14+	0	0	0	0	0	0
	18+	0	0	1450	3585	0	5035
	Sub-total	**25886**	**7942**	**1830**	**15639**	**27354**	**78651**
Tiger	14+	0	0	0	1263	0	1263
Trout	**Sub-total**	**0**	**0**	**0**	**1263**	**0**	**1263**
Total		76026	225115	3265	67846	83245	455497

Table 2. Pounds of trout produced at the Division's five fish hatcheries in FY2017 (fall 2017 and spring 2018).

Hatchery	Species	Size Category (inches)	Number	Weight (Pounds)
Palmer	Landlocked salmon	8+ inches	16,736	2,795
Palmer	Brook trout	eggs	776,322	N/A
	Brown trout	eggs	394,611	N/A
Sandwich	Brook trout	eggs	234,768	N/A
	Brown trout	eggs	294,272	N/A
	Tiger trout	eggs	217,664	N/A

Table 3. Summary of landlocked salmon, brook trout eggs, brown trout eggs and tiger trout eggs produced in FY2018 (fall 2017 and spring 2018).

Photo by Troy Gipps/MassWildlife

4. Hatchery Program Personnel

Susan Townsend, Wildlife Technician III, retired from McLaughlin Hatchery in November after more than 35 years of service to the Division. Megan Cruz was hired to fill the Wildlife Technician III vacancy created by Townsend's retirement. Megan, a graduate of the University of Connecticut, worked in salmon hatcheries in Alaska for four years before coming to MassWildlife. Karl Zukauskas, Wildlife Technician II at the Roger Reed Hatchery, resigned in November to take a position in another state. Cameron Young transferred from Sandwich Hatchery to the Roger Reed Hatchery to fill the vacancy created by Zukauskas' resignation. The Wildlife Technician II vacancy created by the transfer of Young to Roger Reed is in the process of being filled.

VI. Coldwater Fisheries Project, Adam Kautza, Ph.D., Project Leader

As coldwater fisheries project leader I am tasked with developing applied research and monitoring projects aimed at conservation, protection, and sound management of our coldwater fisheries resources. I work closely with many individuals from our field headquarters office, our district wildlife offices, and other outside organizations and agencies to accomplish this work. Lately, we've been focusing on some of our more popular and productive coldwater streams, the Swift and Deerfield, to learn more about their trout fisheries. We've also continued our focus on learning more about our vast wild trout resources in smaller streams across the state and developing a comprehensive wild trout management plan. As part of developing the wild trout management plan I am chairing the Rivers and Streams Technical Committee made up of biologists and managers from around the region who work in wild trout management. It is a forum for sharing ideas and strategies for wild trout management. Finally, outreach is an essential part of my role and I continue to present the virtues of our coldwater fisheries and the findings from our monitoring and research projects to various groups.

<u>Swift River</u>:

There are somewhat limited recent fisheries data from the Swift River tailwater, which is arguably the most popular coldwater fishery in Massachusetts. Moving forward, and teaming with Connecticut Valley District Fisheries Biologist Brian Keleher, we have made investigating the coldwater fishery in the Swift River a top priority. Beginning at the end of FY 2017/18 we began comprehensive electrofishing surveys to develop a baseline in which to monitor changes in coldwater fish populations over time and to begin answering important questions regarding the status of the fishery.

Initially in late June 2017 we completed 15 surveys of the Swift River, 13 in the tailwater section (from above Route 9 to the impoundment) and 2 further downstream. We completed an additional 15 surveys at late June 2018 at several of the 2017 study reaches. However, in 2018 we also included additional study reaches in the popular year-round Catch-and-Release section above Route 9 to Windsor Dam.

In 2017, we found 904 Brook Trout ranging from young-of-the-year all the way up to over 17 inches in the tailwater section of the Swift River. On average there are over 2500 Brook Trout/mile in the Swift River tailwater, a far greater abundance than found in the average Brook Trout stream in Massachusetts and greater than nearly any other waterway in the state. Brook Trout were most abundant in the upper 1/3 of the river, roughly upstream of the Connecticut Valley District Office. No Brook Trout were found in the impoundment downstream of the Cold Spring Road Bridge. We found 40 Rainbow Trout up to 20", mostly in the seasonal and year-round catch-and-release sections of the river. We surveyed only 12 Brown Trout although most were quite large and one individual was an exceptional 33" and over 17 lbs. We found no evidence of natural reproduction of Brown Trout. There were some young-of-the-year and juvenile size Rainbow Trout (<140mm), however these were only surveyed downstream of the "Pipe Pool" and without further evidence the simplest explanation is that these individuals are hatchery escapees. Data from June 2018 are not entered or summarized at this time.

In summary, the Swift River supports an abundant population of wild Brook Trout with the potential for larger individuals than found in any other stream in Massachusetts. The Swift also has the ability to hold over stocked hatchery Rainbow Trout and Brown Trout in some reaches – the rainbows mostly in the upper section and the browns further downstream. Both

stocked species have the potential to reach large size if not harvested. The Brown Trout in particular may approach 20 lbs.

Future work on the Swift will be designed to continue surveying the trout population to monitor changes in abundance and size structure over time, assess ages of larger fish to better understand growth rates, and to track the movement and mortality of stocked Rainbow Trout in the year-round catch-and-release area. For example, in late June 2018 we pelvic fin-clipped all Rainbow Trout stocked into the Swift River upstream of Route 9 and will be monitoring how many remain in the reach after one week, one month, and three months post-stocking. This is only a preliminary investigation to form a rough idea about mortality and/or movement of stocked fish out of the catch-and-release section. We hope to develop more rigorous studies going forward.

Wild Trout Management Plan and Wild Trout Stream Surveys:

Beginning about January 2017 I started discussions with my supervisor and other colleagues regarding the development of a wild trout management plan, with data to be collected over the next few years and a long-term plan put into place shortly thereafter. Much of the remainder of FY17 was given to researching trout management plans from other states, scouring our fisheries database for indicators of exceptional wild trout fisheries, and pinpointing streams and stream reaches where additional data on fish assemblage composition, trout population density and biomass, habitat and water quality, access, etc. were necessary. In all we identified 112 (of approximately 1250 total coldwater fishery resources) streams that met minimum criteria for trout relative abundance and size structure to be included in a list of potential "prime" wild trout fisheries. In our selection process we wanted to narrow down the rather large number of coldwater fisheries into a condensed group of what we could consider, potentially, the best wild trout streams in terms of trout abundance, size structure, as well as angling access. We limited our selection of the top wild trout streams to those that, from previous surveys, showed evidence of harboring 1) naturally-reproducing populations of Brook Trout, Brown Trout, or both, 2) trout densities (number/mile) at or greater than the 90th percentile for all coldwater fisheries statewide, and 3) presence of multiple age-classes of trout. Streams or stream sections were further omitted if they were too small to be considered viable angling destinations (channel width less than about 4 meters) or had no public access. These streams will be intensively surveyed to form a more complete and quantitative picture of their potential as high-quality wild trout fisheries. Management goals, regulations, and ideas to market these fisheries will be based on the data collected in our upcoming surveys set to completed by 2019 or 2020.

We surveyed 32 reaches across 23 streams, of the 112 selected for this project, during July-early Sept 2017 (FY 2017/18). All of these streams were in the Hoosic and Housatonic River Basins in western Massachusetts. Twelve of the 23 brooks were predominantly Brown Trout, which was not all that surprising given the ubiquity of browns in the more alkaline, high pH streams draining limestone geology found in parts of far western Massachusetts. Four streams were 45-60% Brown Trout. The remaining 7 streams surveyed as part of this project in 2017 were dominated by Brook Trout.

All of the initial batch of streams surveyed as part of this project supported high abundances of Brook Trout, Brown Trout, or both. Abundances in most of these stream reaches exceeded the 90th percentile of trout abundance for streams statewide based on a compilation of all coldwater streams in the database. Some of the 2017 streams far surpassed the 90th percentile, in particular we found several Brown Trout streams with an estimated >2500 Brown Trout/mile and a few Brook Trout streams with an estimated >1500 Brook Trout/mile. All of the stream surveyed showed ample evidence of natural reproduction and wild fish as well as presence of size classes sought after by most anglers. Surprisingly, the abundance and/or biomass of trout in these streams met or exceeded the criteria established for "high-quality" wild trout fisheries in other states in the region. So, at least some of the streams that we would consider to be very high quality coldwater fisheries here in Massachusetts would also be considered very high quality if they happened to be found in places like Pennsylvania or Maine.

The winter of 2017/18 was also spent working on summarizing all of our coldwater fisheries data into GIS maps based on abundance per mile of the different species (Brook, Brown, and Rainbow Trout) and

abundance per mile of different size classes for each species (e.g., young-of-the-year, >150mm, >200mm, etc.). These maps will be used to summarize the extent of coldwater stream miles in different watersheds and visualize the various levels of abundance and rough size structure for the different species in streams across watersheds and regions of the state. For example, we can use these summaries and maps to visualize the areas in Massachusetts where we have concentrations of abundant wild Brown Trout populations with larger than usual individuals also present.

Deerfield River Wild Brown Trout:

Partly as a result of the FERC dam operation relicensing process and partly from a keen interest by the Deerfield Chapter of Trout Unlimited to partner with MassWildlife, we put together a study plan to investigate the Brown Trout fishery and more specifically to answer questions about Brown Trout recruitment and the contribution of wild Brown Trout to the fishery in the Deerfield River below Fife Brook Dam. We will be assessing abundance, size structure, growth, and the contribution of wild fish to the fishery. We began by adipose clipping all 1000 hatchery Brown Trout that were stocked into the upper Deerfield River. We worked closely with personnel at Bitzer Hatchery and the Western District to complete the clipping and stocking of clipped fish. Actual in-river survey work will begin in FY 2018/2019, including mark-recapture electrofishing surveys.

Deerfield Trout Unlimited has also begun a project on the Deerfield River to gain insight into the overall success of Brown Trout reproduction in the river. They are identifying the location of Brown Trout redds and assessing the presence and viability of eggs deposited in these redds to understand the effects of hydropeaking flow regulation on Brown Trout spawning and egg survival. The Trout Unlimited project will provide interesting information on the very early stages of the Brown Trout life cycle in the river.

At this stage the most important aspect of the Deerfield River project is the opportunity for collaboration and partnership with outside organizations. We will be working closely with Deerfield River Chapter of Trout Unlimited, Greater Boston Chapter of Trout Unlimited, and the Massachusetts–Rhode Island Council of Trout Unlimited. Trout Unlimited has become an important partner in funding part of this research – specifically they've donated a raft, funds to outfit the raft for electrofishing, and tags to individually mark Brown Trout for a mark-recapture study. Other partners have contributed as well, including Regal Engineering in Orange, MA who have donated time and supplies to modify the donated raft frame to make it suitable for electrofishing. Without the raft and associated equipment we would not have the ability to effectively survey larger high-gradient rivers like the Deerfield and as such would not be able to answer important questions regarding the status of coldwater fishes in these types of river systems.

Northeast Fisheries Administrators Association (NEFAA) Rivers and Streams Technical Committee:

I was tasked with chairing the NEFAA Rivers and Streams Technical Committee starting in January 2018. The committee had been set up to focus on improving communication to better share ideas, methods, and management strategies and plans among agencies who all deal with similar issues pertaining to managing wild trout resources in flowing waters. One of my initial tasks for this committee was to pull together and summarize all of the wild trout management plans, trout stream management plans, etc. for all of the participating states and Canadian provinces for my own knowledge. In addition to that we have now held three conference calls with fisheries biologists and managers from 11 states and 2 provinces. In the calls we have finalized formal "Problem" and "Need" statements to guide the committee direction (shown here) :

> Problem —
> Targeted management and diverse angling opportunities for wild stream-dwelling salmonids (e.g., native, naturally-reproducing Brook Trout in most cases, but also introduced, naturally-reproducing Brown Trout and Rainbow Trout in some situations, and native or introduced naturally-reproducing Landlocked Atlantic Salmon in a few cases) have become increasingly important outcomes desired by the angling public. States and provinces in the region are addressing this by developing, or revising, wild trout or trout stream-specific management plans. However, many state and provincial resource management agencies lack some of the necessary data, experience,

and/or resources to support the development or timely revision of a wild trout management plan.

Need —
Fisheries managers working on wild trout management in rivers and streams throughout the region need an avenue to share their knowledge and experiences with other managers who have been or are currently dealing with similar issues. Providing a means of sharing useful knowledge and experience will allow managers to learn from one another and help to inform the development of useful wild trout management plans with a greater likelihood of successfully meeting intended goals and objectives.

We have also compiled a list of major threats to wild trout and obstacles to effective wild trout management each state/province experiences, and briefly discussed which data and information to share and how best to share it. Our next steps will be to further discuss data/information sharing and move forward with that in an attempt to benefit all participants as they develop new wild trout management plans or revise existing wild trout management plans.

Outreach:

I've continued to do multiple presentations to angling and conservation groups throughout Massachusetts outlining the status of coldwater fisheries in the state and discussing the work we are doing to study and manage these resources. These groups include local Trout Unlimited chapters, fly fishing organizations such as Western Massachusetts Flyfishers and other fishing clubs, fly shops, etc.

IV. Fisheries Operations, Steven Mattocks

1. Biological sampling for fish community assessment

The annual fisheries stream sampling protocol, priorities, and fish identification meeting was held on June 11th, 2018, and was attended by district fisheries biologists and technicians across the state. Stream sampling priorities, sampling protocols, and fish identification were major themes of the meeting. Stream survey protocols were discussed, and fish identification exercises were conducted with the district biologists and technicians as an annual refresher of survey techniques and fish identification features. Priority sampling lists were supplied to district staff at the annual meeting as well as the updated fisheries database, fisheries GIS layers, and voucher collection specimen needs.

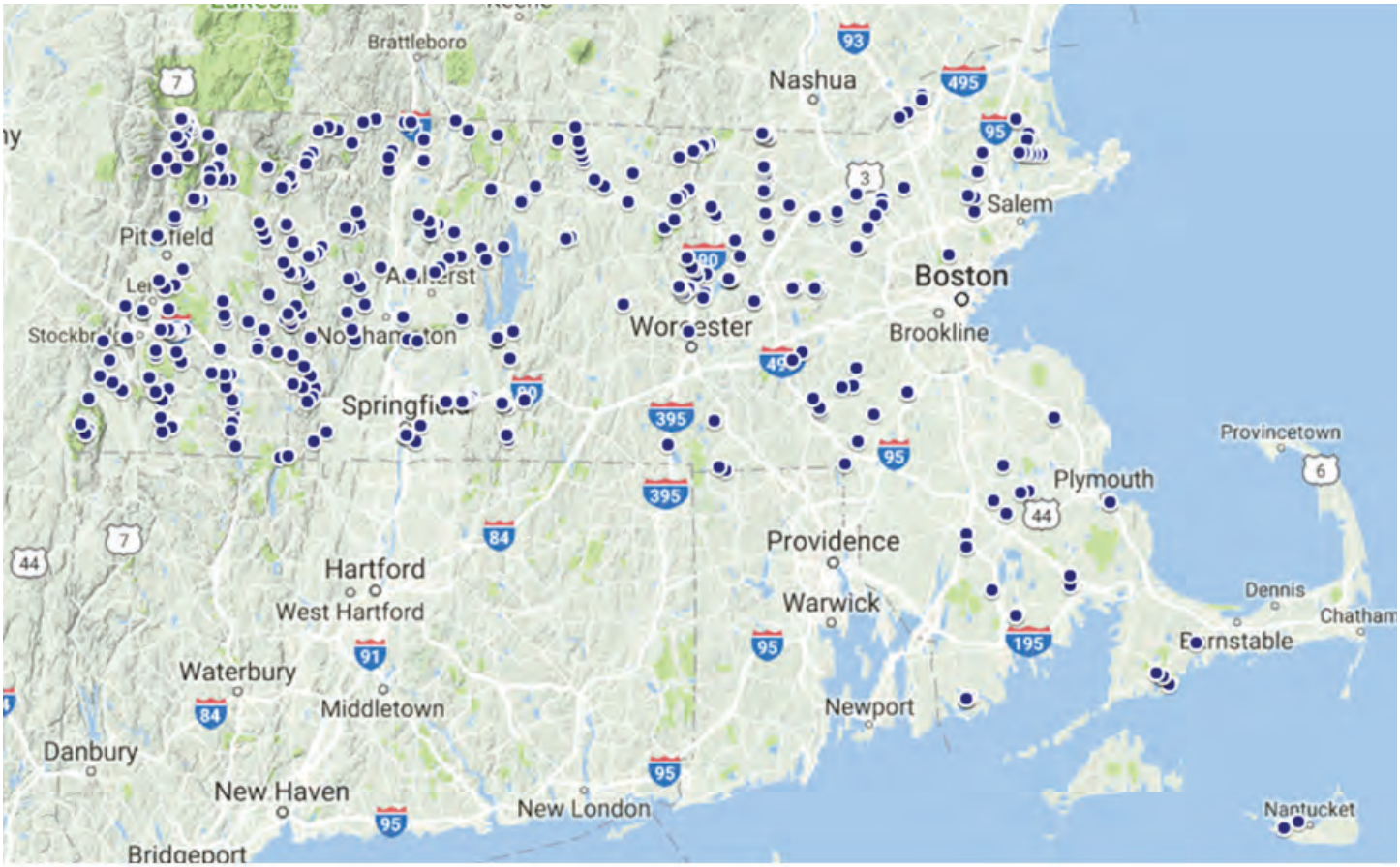
Stream and lake sampling priorities were generated by field headquarters fisheries staff prior to the annual meeting, and before the start of the sampling season. Survey locations were prioritized based on criteria formed by fisheries staff (e.g. gaps in current fisheries data, streams with historical surveys, potential rare and endangered species occurrence, and potential locations for naturally reproducing coldwater fish). In addition, surveys were prioritized to fulfill data requests submitted by internal and external sources. Stream survey priorities were reviewed by fisheries biologists and any notes or changes to the lists were made prior to the annual meeting. Logistical challenges that occurred during sampling coordination and prioritization among field headquarters staff were also addressed. Weekly communication with field headquarters project leaders and regular correspondence with district staff was integral in maximizing sampling and overall operation efficiency.

In FY 2018, a new monitoring initiative was established to assess juvenile American Shad productivity in the Connecticut River above 3 main-stem dams. In coordination with Valley District and USFWS, random boat electrofishing runs were sampled in 3 dam sections within the Connecticut River: Holyoke to Turner's, Turner's to Vernon, and Vernon to Bellows. MassWildlife covered the Holyoke to Turners dam section with nighttime electrofishing. An annual monitoring report was produced, titled "Juvenile American Shad Assessment in the Connecticut River – Fall 2017", which can be found on the USFWS Connecticut River Conservation web page (https://www.fws.gov/r5crc/pdf/MDFW_USFWS_Shad_Assessment_4_20_18_final.pdf).

2. Data entry and QAQC

MassWildlife staff conducted 405 surveys throughout the state during FY 2018 (Figure 1). Stream surveys were conducted in all districts throughout Massachusetts, and sampling locations filled many data gaps. Some surveys were conducted on streams and rivers that

Figure 1. Four hundred and five (405) Biological fish sampling locations throughout Massachusetts in FY 2018.



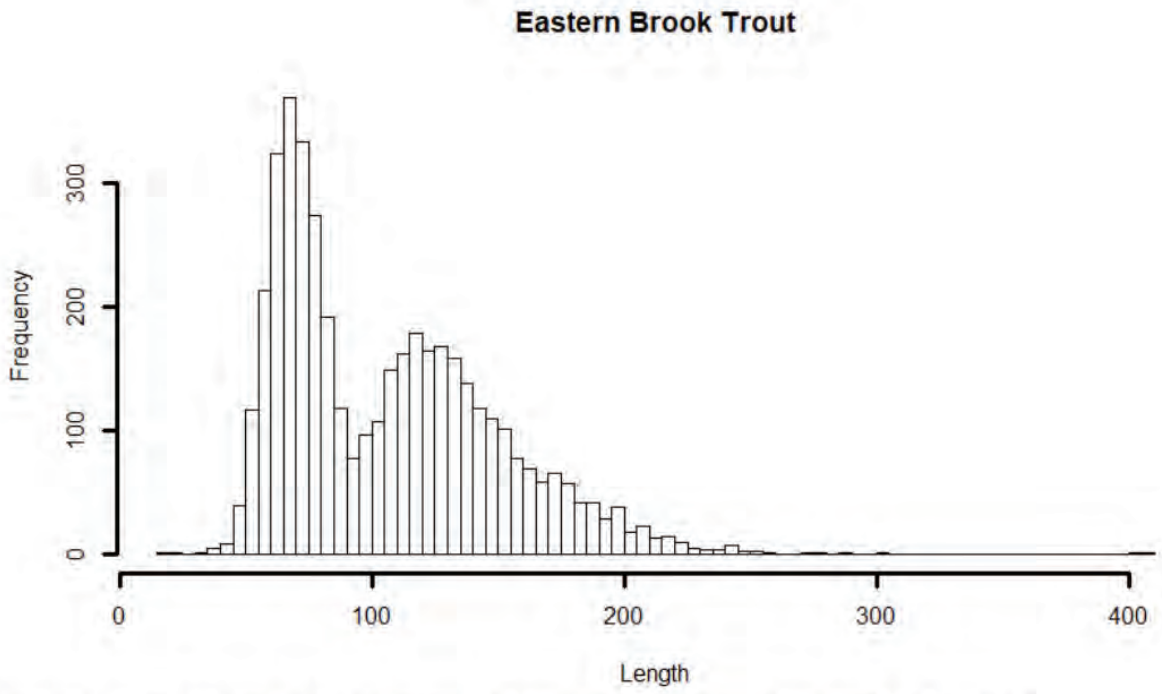


Figure 2: Length frequency histogram for eastern brook trout captured in FY 2018.

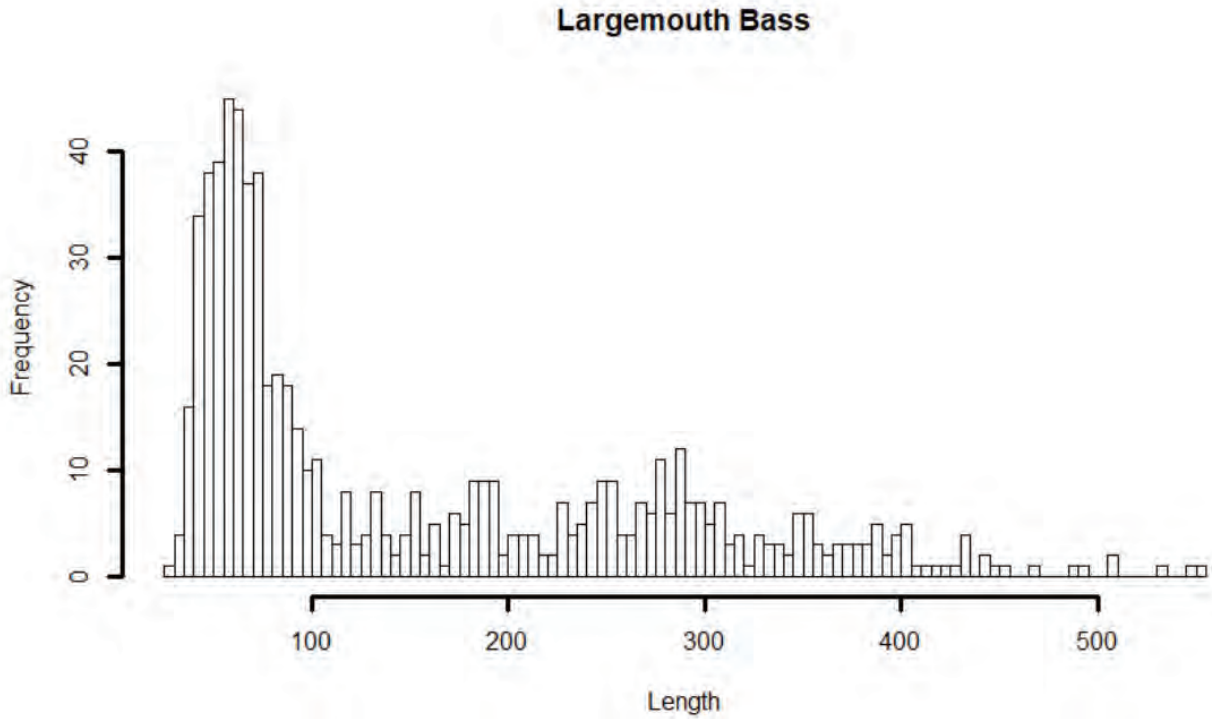


Figure 3: Length frequency histogram for largemouth bass captured in FY 2018.

Table 1: Number of samples conducted within Massachusetts watersheds during FY 2018 surveys.

Watershed	Number of Samples
Bashbish	4
Blackstone	5
Buzzards Bay	9
Cape Cod	6
Charles	9
Chicopee	31
Concord	22
Connecticut	37
Deerfield	24
Farmington	15
French	1
Hoosic	31
Housatonic	43
Ipswich	11
Islands	2
Merrimack	5
Millers	13
Mystic	1
Nashua	63
Neponset	2
North Coastal	1
Parker	5
Shawsheen	1
South Coastal	4
Taunton	8
Westfield	52

Table 2: Number of species captured during FY 2018 surveys.

Species Code	Number of Fish	Species Code	Number of Fish
A	7	LC	99
AE	1067	LLS	367
AS	3	LMB	701
ATS	3	LND	4888
B	2543	LNS	230
BB	268	LT	270
BBH	3	M	43
BC	85	NP	3
BM	69	P	1672
BND	12486	RB	260
BNM	214	RBS	440
BS	69	RP	421
BT	2354	RT	34
C	78	S	11
CC	1	SC	4041
CCS	59	SD	9
CLM	836	SL	94
CM	82	SMB	771
CP	397	SNS	2
CRC	1712	SS	159
CS	3042	TD	540
EBT	4307	TT	2
F	1605	WC	2
FM	13	WP	45
GS	552	WS	2546
GSF	18	YB	306
K	37	YP	1552

had previous samples, while other surveys occurred on streams with historical surveys or even no previous data. Additional CFR's were added which documented the reproduction of coldwater fish. The continued surveying of Massachusetts waters allows for monitoring changes in fish assemblages over time and space.

Surveys were completed in every major watershed within the state (Table 1). Species summaries were produced, which include the minimum, maximum, and average lengths of each species captured (Table 3), as well as the total number of fish captured (Table 2). This information captures size and community structure of fishes sampled in FY 2018.

All fisheries survey data collected by district and field headquarters staff were entered into the fisheries survey and inventory database. Data was then checked for quality and accuracy using pivot tables in Microsoft Excel, R scripts and table outputs using R Studio, as well as graphical displays (box plots, scatterplots). Length frequency histograms were plotted for eastern brook trout (Figure 2) and largemouth bass (Figure 3), indicating size ranges. Errors in data were corrected before updating GIS layers.

Watershed voucher collections were updated with fish collected by MassWildlife staff during fish surveys. Fish that were missing from voucher jars were added (if surveyed and vouchered), and a new voucher request list was generated and provided to district staff.

3. Data summaries and requests

Table 3: Minimum, maximum and average lengths of fish species displayed by species code. All fish were collected during FY 2018 surveys.

Species Code	Min Length	Max Length	Avg Length	Species Code	Min Length	Max Length	Avg Length
A	48	81	65	**LC**	48	105	75
AE	60	960	242	**LLS**	61	644	206
AS	103	204	166	**LMB**	29	555	154
ATS	118	138	127	**LND**	24	195	73
B	21	231	92	**LNS**	30	219	114
BB	24	368	154	**LT**	353	888	539
BBH	275	335	315	**M**	23	105	63
BC	25	319	186	**NP**	512	815	682
BM	27	66	42	**P**	28	202	91
BND	15	118	53	**RB**	27	297	124
BNM	32	91	72	**RBS**	32	180	92
BS	33	152	64	**RP**	51	221	108
BT	43	498	122	**RT**	210	408	323
C	270	840	561	**S**	82	92	86
CC	159	159	159	**SC**	16	130	63
CCS	29	189	100	**SD**	43	56	50
CLM	27	151	75	**SL**	54	250	127
CM	25	107	62	**SMB**	35	530	109
CP	44	607	186	**SNS**	910	1020	965
CRC	19	200	69	**SS**	47	131	81
CS	22	288	68	**TD**	18	111	62
EBT	19	406	107	**TT**	122	385	254
F	24	338	87	**WC**	307	330	319
FM	37	60	50	**WP**	99	397	211
GS	24	283	89	**WS**	18	578	119
GSF	45	143	77	**YB**	32	345	143
K	38	108	64	**YP**	19	342	155

Multiple data requests were received during FY 2018. After data needs were outlined by individuals or organizations making the requests, data were partitioned using Excel or R Studio. Data release agreements were provided by the Operations Biologist prior to submitting data from the fisheries survey and inventory database. Many requests were made by individuals seeking information on fishing locations. Sampling requests by state, federal, and non-government agencies were also frequent.

Future sampling requests were also annotated and coordinated by the Operations Biologist. If the sampling request fit within the MassWildlife fisheries sampling goals and priorities, requested locations were added to priority sampling lists for either district staff or field headquarters biologists.

4. Other management assignments and activities

Public engagement is critical for communicating the

science and management practices of MassWildlife, and engaging stakeholders is important for recruiting anglers and support for recreational fishing. The Operations Biologist participated in multiple electrofishing demonstrations for various organizations, including boat and backpack demonstrations for Framingham State University and UMass Amherst. In addition, multiple natural resource meetings were attended to increase outreach and collaboration (Northeast Climate Science Center, USFWS, USGS). Regular communication with other state agencies including DER, DCR, DOT, DMF, and DEP was integral for maximizing interagency collaboration and resource monitoring efficiency.

To update and maintain field equipment for fisheries sampling, new gear was budgeted for, and ordered. Major gear purchases and upgrades during FY 2018 include gillnets, boat electrofishing upgrades, a new 12' Crestliner aluminum boat used as a portable electrofishing unit, temperature loggers, and a myriad of other items integral to fisheries surveys. Outboard motors and small engines (generators) were winterized and maintained according to manufacturer recommendations.

Scientific Collection Permit renewal applications were logged in coordination with Bob Arini. Operations Biologist also logged fisheries data collected by scientific collection permit holders.

Sandwich Hatchery staff gather Brown and Brook Trout in preparation for Tiger Trout spawning in the late fall.

Fisheries Staff

Westborough Field Headquarters Staff

Todd A. Richards, Assistant Director, Fisheries
Richard Hartley, Environmental Review and Sportfish Awards Project Leader (No report submitted due to extended leave)
Adam Kautza, Ph.D., Coldwater Fishery Resource Project Leader
Steven Mattocks, Field Operations Biologist
Rebecca Quiñones, Ph.D., Stream and River Project Leader
Ken Simmons, Ph.D., Chief Fish Culturist
Caleb Slater, Ph.D., Anadromous Fish Project Leader
Jason Stolarski, Ph.D., Watershed Project Leader
David Szczebak, Fisheries GIS Project Leader

McLaughlin Hatchery Staff

Jim Hahn, Manager
Kurt Palmateer, Assistant Manager
John Sousa, Assistant Manager
Jennifer Ayre, Bacteriologist
Mark Coughlin, Wildlife Technician
Jeremy Davis, Wildlife Technician
Chris Kielbasa, Wildlife Technician
Chris Paterson, Wildlife Technician
Susan Townsend, Wildlife Technician (retired 2018)

Montague Hatchery Staff

John Williams, Manager
Holly Hubert, Assistant Manager
Chester Hall IV, Wildlife Technician
Joe Kendal, Wildlife Technician

Roger Reed Hatchery Staff

Daniel Marchant, Manager
Arthur Pellegri, Assistant Manager
Karl Zukauskas, Wildlife Technician (part year)
Cameron Young (started 2018)

Sandwich Hatchery Staff

Adam Davies, Manager
Greg McSharry, Assistant Manager
Conor McMorrow, Wildlife Technician
Mike Chandler, Seasonal

Sunderland Hatchery Staff

Charles Bell, Manager
Brian Guerin, Assistant Manager
Timothy Nye, Wildlife Technician
Andrew Ostrowski, Wildlife Technician
Richard Pecorelli, Wildlife Technician
Heather Sadler, Wildlife Technician

Wildlife

Michael Hugenin
Assistant Director, Wildlife Research

Overview

The Wildlife Section is responsible for the conservation, management, and research of wildlife and game populations within the Commonwealth of Massachusetts. The Wildlife Section has 2 vacancies and currently consists of 17 staff members, including 6 Habitat Biologists, 4 Wildlife Project Leaders, 3 Wildlife Biologists, 1 Landscape/Population Ecologist, 1 Ornithologist, 1 Habitat Program Leader, and 1 Assistant Director. In general, the Wildlife Section conducts habitat management to maintain and enhance biodiversity on state Wildlife Management Areas (WMA), implements and coordinates bird conservation programs, and conducts research and collects harvest data to manage game populations in order to maintain healthy populations and support wildlife-dependent recreational opportunities.

The Wildlife Section manages wildlife and wildlife habitat by developing science-based regulatory, policy and programmatic recommendations, which are ultimately approved by the Fisheries and Wildlife Board. Specifically, the Wildlife Section implements habitat management for a diverse suite of species through cutting, mowing, burning, invasive plant species control, etc. Also, the Wildlife Section is responsible for managing deer, moose, black bear, furbearer, wild turkey, upland game, waterfowl, and other migratory bird populations. Management recommendations and strategies are based on research designed to understand wildlife population dynamics while considering biological and social variables. The Wildlife Section oversees the hunting and trapping seasons and allocates and issues permits for antlerless deer, wild turkey, and black bear. Further, the Wildlife Section issues permits for and oversees commercial game preserves, Problem Animal Control (PAC) agents, falconry, crossbows, commercial deer farms and other propagators facilities. The statewide pheasant stocking program is also coordinated through the Wildlife Section in addition to a 3-day paraplegic hunt for deer.

Aside from the above mentioned responsibilities, staff time and resources are consumed by coordinating and managing the agency's Large Animal Response Team (LART), responding to reports of human-wildlife conflicts, media inquiries, public records requests, and representing the agency on wildlife conservation and management issues in public forums and in partnership with local, state, federal, and private organizations. Additionally, staff provide technical assistance on habitat assessments for proposed management on DCR and other public and private forestlands, serve as the wildlife representative on the agency's land acquisition committee, direct and coordinate with the University of Massachusetts and the USGS Cooperative Fish and Wildlife Research Unit on scientific wildlife research projects within the Commonwealth of Massachusetts. Project leaders and managers serve as the state representatives on the Northeast Association of Fish and Wildlife Agencies' various technical committees and Northeast Association of Wildlife Administrators respectively.

The Wildlife Section has experienced some turnover during FY18. Assistant Director of Operations, Michael Huguenin continued as Acting Assistant Director of Wildlife following the departure of Laura Conlee in FY17. Michael Huguenin subsequently applied for, interviewed and was offered the position of Assistant Director of Wildlife and was appointed on October 30, 2017. Michael Huguenin then continued as Acting Assistant Director of Operations until the position was filled by Trina Moruzzi on November 9, 2017. Trina Moruzzi began the year as a Wildlife Biologist IV in the Wildlife Section. Following Trina's promotion, her position was changed from a Wildlife Biologist IV to a Wildlife Biologist III. Following an interview, Susan McCarthy (Wildlife Biologist I in the Wildlife Section) was promoted to Wildlife Biologist III in May, 2018.

Habitat Program
John Scanlon, Habitat Program Supervisor

The Habitat Program is a component of the MassWild-

life Biodiversity Initiative, which in part seeks to maintain and restore the native diversity of birds and mammals through active land management. The Habitat Program's objectives are to:

Provide a spatial and temporal distribution of habitats for birds, mammals, and other species of conservation concern (including but not limited to grassland, marshland, shrubland, young forest, and late-seral stage forest habitats) on WMA and WCE lands throughout Massachusetts.

Provide technical assistance to other public and private landowners and conservation organizations on management of grassland, marshland, shrubland, and young forest habitats.

The Habitat Program facilitates applied management across a range of upland and wetland sites on both public and private lands to conserve birds, mammals, and other wildlife identified as species of conservation concern in the Massachusetts State Wildlife Action Plan (SWAP). Upland sites include grasslands, shrublands, and forestlands. Wetland sites include marshlands, shrub swamps, and forested swamps. Applied management practices include invasive plant control, mowing, prescribed burning, and tree clearing.

Habitat Program staff contract and administer these practices across >190,000 acres of Wildlife Management Areas (WMAs), and provide technical assistance to other public and private landowners interested in applied management to conserve wildlife. This includes reviewing harvest proposals for Town forestlands, DCR State forestlands and Federal U.S. Army Corp of Engineers flood control lands, and planning harvesting operations on private forestlands that are funded through the NRCS Working Lands for Wildlife Initiative and the NRCS Young Forest Regional Conservation Partnership Program (RCPP).

In addition, Habitat Program staff assist the MassWildlife Realty Program and District offices with land acquisition, and with monitoring of >150 Wildlife Conservation Easements (WCE's) on >40,000 acres of private lands. Habitat Program staff also assist with reviewing and prioritizing applications for funding under the MassWildlife Habitat Management Grant Program.

The Habitat Program follows landscape composition goals for WMAs approved by the Massachusetts Fisheries & Wildlife Board that include 20-25% early-successional habitat (including 1-2% grassland, 8-9% shrubland, and 11-14% young forest habitat ≤30 years old), 65-75% closed canopy forest habitat between 30-150 years old, and 10-15% biologically mature forest habitat ≥150 years old. Habitat Program staff actively participate in the MassWildlife prescribed fire crew to conduct prescribed burns on fire-associated habitats in compliance with the MassWildlife Prescribed Fire Policy. Habitat Program staff also conduct small scale invasive plant control efforts on WMAs in compliance with all local, state, and federal permitting requirements.

In addition, Habitat Program staff contract and administer commercial tree clearing, mowing, mulching, stumping, harrowing, seeding, and invasive plant control contracts to restore and enhance grassland and shrubland habitats on WMAs through existing statewide contracts and procurement procedures in compliance with all local, state, and federal permitting requirements. Habitat Program staff also contract and administer commercial forest harvesting operations designed to create young forest habitat through a public, competitive bidding process in compliance with all local, state, and federal permitting requirements.

Project Accomplishments

Project Administration

Habitat Program staff conducted biological monitoring, management planning, and applied active management practices on more than twenty sites in FY2018 to help achieve landscape composition goals for a spatial and temporal diversity of successional habitats at the landscape level (Tables 1-3). Staff assisted with preparation and/or updating of habitat site plans and prescribed burning plans for these WMA's, created and administered habitat management contracts with private vendors at these sites, and planned or contracted biological monitoring at these sites. Habitat Program staff also maintained GIS databases of management and monitoring information for these sites.

Biological Monitoring

Regular monitoring is essential for practicing adaptive natural resource management and typically includes one or more of the following: 1) vegetation sampling to determine the relative abundance of all vascular plants in the forest understory and overstory and to determine regeneration success of desired tree species on harvested sites; 2) identification and location of

Table 1. FY2018 Biological Monitoring Sites

Site Name	Town	Type of Monitoring	Acres
Birch Hill WMA	Royalston/Winchendon	Breeding Bird Survey	60
Camp Cachalot/SE Pine Barrens	Carver	Breeding Bird Survey	140
Farmington River WMA	Otis	Breeding Bird Survey	80
Fox Den WMA	Middlefield	Vegetation Survey	40
Frances Crane WMA North	Falmouth	Breeding Bird Survey	180
Herman Covey WMA	Belchertown	Vegetation Survey	120
Mashpee Pine Barrens WMA	Mashpee	Breeding Bird Survey	50
Mill Brook Bogs WMA	Freetown	Vegetation Survey	20
Quashnet Woods SR/WMA	Mashpee	Breeding Bird Survey	60
Southwick WMA	Southwick	Breeding Bird Survey	20
Squannacook WMA	Shirley	Vegetation Survey	200
Total			**970**

Table 2. FY2018 Habitat Planning Sites

Site Name	Town	Plan Type	Acres
Birch Hill WMA	Winchendon	Habitat Site Plan	3,760
Bolton Flats WMA	Lancaster	Prescribed Burn Unit Plans	108
Camp Cachalot WCE/ Southeast Pine Barrens WMA/Maple Springs WMA/Myles Standish SF	Plymouth & Carver	Prescribed Burn Unit Plans	1,000
Fox Den WMA	Middlefield	Draft Habitat Site Plan	1,050
Frances Crane WMA North	Falmouth	Prescribed Burn Unit Plan	400
Herm Covey WMA	Belchertown	Prescribed Burn Unit Plan	400
Jug End Fen WMA	Egremont	Prescribed Burn Unit Plan	25
Leyden WMA	Leyden	Prescribed Burn Unit Plan & Draft Habitat Site Plan	21
Montague Plains WMA	Montague	Prescribed Burn Unit Plan	120
Muddy Brook WMA	Hardwick	Prescribed Burn Unit Plan	57
Total			**7,061**

invasive plants for subsequent control efforts; 3) identification and location of rare plants in order to design appropriate mitigation during harvesting activities; 4) photo documentation of pre- and post-harvest conditions; and/or 5) wildlife sampling to determine habitat use (e.g., breeding bird surveys, butterfly/moth surveys).

During FY2018, Habitat Program staff conducted biological monitoring on 970 acres (Table 1). This included pre-treatment monitoring of herbaceous vegetation including ferns, and broadleaved non-woody plants on previously unmanaged portions of the Mill Brook Bogs and Squannacook WMAs, post-treatment vegetation monitoring on managed portions of the Fox Den and Herman Covey WMAs, and breeding bird surveys on seven previously managed sites (Table 1).

Habitat Management Planning

Habitat Site Plans and companion Fire Management and/or Prescribed Burn Unit Plans were undertaken at ten properties totaling more than 7,000 acres (Table 2). Habitat Site Plans are prepared for all MassWildlife properties where active habitat management will occur. In addition to these habitat plans, those properties that include fire-associated natural communities such as native warm-season grasslands or scrub oak barrens also have Prescribed Burn Unit Plans developed as required by the MassWildlife Prescribed Fire Policy and Handbook (https://www.mass.gov/files/documents/2017/09/20/fire-policy-handbook-4-19-17.pdf).

Unit plans provide details on fuel types, fuel loads, fuel breaks, and required fire prescription parameters such as wind speed and direction, relative humidity, fuel moisture content, crew composition and fire equipment. Lastly, for the small subset of MassWildlife properties that both support fire-associated natural communities and occur within a regional landscape where human safety and development are at risk due to additional fire-associated natural communities that occur nearby but outside the WMA, Fire Management Plans are prepared to coordinate prescribed burning on MassWildlife lands with wildfire control on adjacent fire-prone lands and associated development.

Habitat Management Practices

More than 1,100 acres were treated with one or more management practices by Habitat Program staff in FY2018 (Table 3). Applied practices included invasive plant control on more than 500 acres, mowing on 280 acres, prescribed burning on nearly 400 acres, and tree clearing on 60 acres.

Wildlife Conservation Easement and Fee Ownership Compliance Monitoring

Compliance monitoring for WCEs involves site visits to timber sales and other forest cutting operations on private lands where DFW owns development and public access rights. In FY2018, monitoring of Forest Management Plans and/or active Forest Cutting operations occurred at six WCE's totaling 290 acres (Table 4). Habitat Program staff advocated for substantial felling of low quality stems, inclusion of >2 ha young forests openings, and retention of downed woody debris and biological legacies where appropriate.

Technical Assistance and Coordination

The Habitat Program provided technical assistance on on nine proposed harvesting operations totaling 1,242 acres on town, state, and federal forest lands across Massachusetts (Table 5). MassWildlife Habitat Program staff advocated for inclusion of >2 ha young forest openings, and for consideration of barrens restoration efforts where appropriate.

Table 3. FY-2018 Habitat Management Sites

Site Name	Town	Habitat Type	Treatment	Acres
Berkshire Conservation Lands	Stockbridge	Forest	Invasive	20
Bolton Flats WMA	Lancaster	Grassland	Mow	108
Burrage Pond WMA	Halifax	Freshwater Wetland	Invasive	10
Dunstable Brook WMA	Tyngsboro	Young Forest	Invasive	10
Frances Crane WMA	Falmouth	Grassland	Burn	165
Frances Crane WMA	Falmouth	Grassland	Mow	75
Frances Crane WMA	Falmouth	Pitch Pine/Oak Woodland	Invasive	217
Frances Crane WMA	Falmouth	Pitch Pine/Oak Woodland	Tree Clear	25
Frances Crane WMA	Falmouth	Pitch Pine/Oak Woodland	Burn	20
Herman Covey WMA	Belchertown	Shrubland & Grassland	Mow	30
Leyden WMA	Leyden	Lowbush Blueberry Shrubland	Invasive	33
Montague Plains WMA	Montague	Pitch Pine/Oak Woodland	Mow	70
Montague Plains WMA	Montague	Pitch Pine/Oak Woodland	Invasive	25
Muddy Brook WMA	Hardwick	Pitch pine/Scrub oak Woodland	Burn	40
Penikese Island WMA	Gosnold	Shorebird Nesting	Burn	70
Red Brook WMA	Plymouth	Freshwater Wetland	Erosion	3
Southwick WMA	Southwick	Grassland	Invasive	190
Southwick WMA	Southwick	Grassland	Tree clear, stump, harrow, seed	36
Total				**1,147**

Table 4. FY2018 WCE Monitoring

WCE Name	Town	Acres
Flagg Mountain WCE	Conway	50
Honey Pot WCE	Westfield	25
Rockhouse Mountain WCE	Bernardston	70
Satan's Kingdom WCE	Bernardston	20
Westfield Watershed WCE	Montgomery	50
Windsor Brook WCE	Dalton	75
Total		**290**

Table 5. FY2018 Technical Assistance Reviews

Property	Parcel	Town	Acres
H.O. Cook State Forest	Cricket Hill Lot	Conway	275
J. Harry Rich State Forest	Nod Road Lot	Groton	45
Lindon W. Bates State Park	Ole Shaker Lot	Hancock	195
October Mountain State forest	No Signal Lot	Washington	59
October Mountain State Forest	Sykes Mountain Lot	Pittsfield	218
Pumpkin Brook Conservation Area (Town of Shirley)	Townsend Street Lot	Shirley	20
Shawme Crowell State Forest	Pine Street Lot	Sandwich/Barnstable	10
Shutesbury State Forest	Macedonia Road lot	Shutesbury	253
USACE Birch Hill Dam	East Street Lot	Gardner	167
Total			**1,242**

Private Lands NRCS Habitat Program
Marianne Piche, NRCS Habitat Biologist

NRCS/MassWildlife Partnership: Two Habitat Program staff work in coordination with Natural Resource Conservation Service (NRCS) staff under the Working Lands for Wildlife initiative and the Young Forest Regional Conservation Partnership Program (RCPP) effort to conduct active management for early-successional habitats on private lands.

The Natural Resources Conservation Service (NRCS) provides technical and financial assistance to private landowners and land managers who voluntarily agree to apply practices on their land for the conservation and improvement of natural resources, including habitat for wildlife and fisheries. Under Cooperative Agreement MassWildlife provides NRCS in Massachusetts with the services of two Habitat Biologists, one who is responsible for providing specific wildlife habitat recommendations to NRCS staff for the development of Environmental Quality Incentive Program (EQIP) or Wetland Reserve Easement (WRE) funding applications and in promoting the conservation and improvement of habitat for wildlife and fisheries resources, and another who is responsible for providing specific wildlife habitat recommendations to NRCS staff for the development of Young Forest RCPP. The Habitat Biologists work directly with NRCS staff to plan, implement, and supervise wildlife conservation practices associated with their funding programs and serve as the liaisons between MassWildlife and NRCS in regards to Working Lands for Wildlife and Young Forest RCPP species. These include New England Cottontail, Bog Turtle, and NRCS Northeast Turtle Project species (Wood Turtle, Blanding's Turtle, and Spotted Turtle) under Working Lands for Wildlife, and Golden-winged warbler, American woodcock, and ruffed grouse under the Young Forest RCPP.

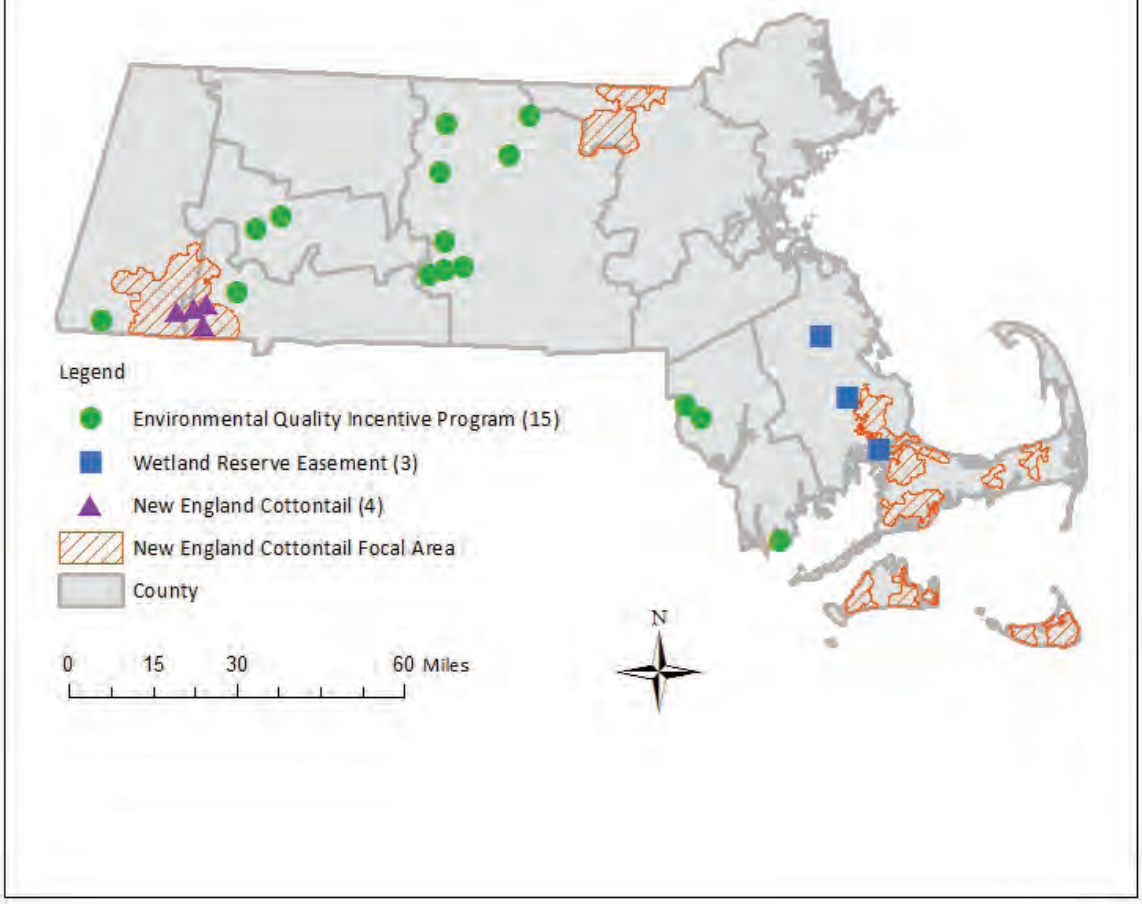
In FY18 the Working Lands for Wildlife Habitat Biologist visited private properties to assist in planning habitat management projects for EQIP, WRE, and New England Cottontail (Figure 1). Fifteen properties were visited and written habitat management proposals provided to assist NRCS staff in planning EQIP funding applications. Three sites were visited with NRCS staff

and written habitat management proposals provided for development of WRE restoration plans. In addition, four site visits were conducted and habitat management proposals prepared to plan NRCS funding applications in MassWildlife New England Cottontail focal areas. Funded applications will result in creation, restoration, or enhancement of a variety of State Wildlife Action Plan habitat types including Grassland, Young Forest/Shrubland, Upland Forest, Forested Swamp, Shrub Swamp, Marsh/Wet Meadow, Lake/Pond, and Small Stream.

In addition to assisting NRCS staff with the development of habitat management funding applications, the Habitat Biologist worked to promote NRCS programs. Tables were staffed at the Sheffield Town Forest Event, Soil and Water Conservation Society Conference, and the Massachusetts Land Conservation Conference. Presentations were given at the Massachusetts Forest Alliance annual meeting, a MassDCR Timber Harvester workshop, a Natural Heritage & Endangered Species Program advisory committee meeting, and a Natural Resources Conservation Service wetland workshop. In addition, a Forest Trust and Ruffed Grouse Society sponsored Forest Wildlife Habitat seminar, a Tunxis Club sponsored Creating a Balanced Forest Landscape workshop, two NRCS Partner Recognition events, and a MassWildlife Public Site walk were attended to share information with attendees about NRCS funding programs.

Serving as liaison between MassWildlife and NRCS in regards to Working Lands for Wildlife species, the Habitat Biologist attended the annual New England Cottontail Technical Committee meeting held in New Hampshire and Maine and participated in Technical Committee, Outreach Work Group, and Habitat Management Work Group activities throughout FY18. The

Figure 1: New England Cottontail Focal Areas and
State Fiscal Year 2018 NRCS Cooperative Agreement Habitat Biologist Site Visits



Habitat Biologist along with the Natural Heritage & Endangered Species Program State Herpetologist had several meetings with NRCS staff to plan and coordinate conservation efforts that will be funded by NRCS under the Northeast Turtles Project.

In FY18 Massachusetts hosted the annual Association of Fish and Wildlife Agencies Northeast Habitat Technical Committee meeting held in August. MassWildlife Biodiversity Initative staff worked to coordinate the meeting, participate in advancing chargest to the committee, and lead site walks. Representatives from eight of the thirteen northeast states were in attendance. U.S. Fish and Wildlife Service, the Wildlife Management Institute, Massachusetts Army National Guard, Massachusetts Audubon Society, NRCS, and MassDCR also participated in portions of the meeting. The group visited Muddy Brook WMA to view inland Pine Barrens restoration, Frances A. Crane WMA to observe grassland expansion efforts, and the Massachusetts Audubon Tidmarsh Wildlife Sanctuary to learn about their NRCS funded Wetland Reserve Easement restoration. MassWildlife staff also gave presentations on Restoration and Long-term Research at Montague Plains WMA, MassWildlife District Office Management Activities, the Ecological Impacts of Deer Browse, Tern Habitat Restoration, and Stream Restoration Involving Dam Removal and Culvert Replacement.

The Massachusetts Young Forest (YF) RCPP seeks to provide quality technical assistance to all eligible landowners and managers seeking advice on how to conserve at-risk young forest species. Outreach efforts are focused in areas of the state that are likely to provide the best results for at-risk young forest species based on spatial modeling of species population and habitat suitability data. Once high priority areas are identified, additional spatial modeling is conducted to determine portions of the areas that are well suited to young forest management practices based on soil features, landscape setting, and land-use history. Offering both habitat planning and assistance with the NRCS RCPP application process makes this a full-service program for qualified landowners. In addition, the Massachusetts YF RCPP works cooperatively with other public and private conservation organizations that have similar goals for at-risk YF species across Massachusetts.

This year we successfully provided outreach at 6 events that were attended by a total of approximately 1,500 people, and presented young forest material at two. Technical assistance was provided through site visits to 21 properties that totaled a combined area of 4,623 acres. Of these, this program provided habitat management recommendations to 7 landowners for 474 acres, and assisted 6 landowners with applications for funding on 354 acres for the creation of YF habitat and control of invasive vegetation. Going forward, we plan on producing updated outreach material such as mailers and presentations to clearly communicate why we need more YF habitat, why the best results with YF habitat management are likely to be obtained in targeted portions of the state, and how to properly apply YF management practices on the ground. Groups to target include Massachusetts licensed foresters, licensed loggers, land trusts, and sportsman clubs. Co-hosting workshops with partner organizations would provide a good platform to support our common goals and show the public the array of funding opportunities available for management. These events will be planned for late winter or early spring to coincide with other annual events for groups such as the MA Association of Conservation Commissioners, Society of American Foresters, MA Forest Alliance, and the Massachusetts Land Conference.

Upland Game Program
Dave Scarpitti, Wild Turkey and Upland Game Biologist

Wild Turkey

Hunter participation
In Massachusetts, a hunter who obtains a wild turkey hunting permit can harvest no more than 2 turkeys total in a calendar year. They have the option to harvest up to 2 bearded turkeys during the spring hunting season which then precludes them from fall turkey hunting. If one or zero turkeys are harvested in the spring hunting season, hunters may then have the opportunity to harvest one turkey of either sex during the fall hunting season.

In 2018, approximately 204304 regular (non-youth) wild turkey permits were issued prior to the spring hunting season. The number of spring turkey hunting permits issued in 2018 is slightly lower than in previous years but still in excess of 20000 for the 7th consecutive year. Fall only permit (turkey permits issued after the completion of the spring season) issuance in 2017

was strong, demonstrating continued demand for fall turkey hunting opportunity, 4442 fall only permits were issued in 2016.

Fall 2017 Harvest

The 12 day fall wild turkey hunting season occurred from 23 October – 4 November 2017. Fall season length was expanded from a 6-day to a 12-day season statewide, and expanded into WMZ's 10-12 in 2012. A total of 193 wild turkeys were harvested, which is roughly average compared to the past 5 years. Harvest in the 1st fall season of 1990 was 329.

There were 91 male and 102 female (52.8%) wild turkeys harvested during the 2017 fall hunting season. The proportion of females harvested in 2017 was comparable, but slightly higher to most years over the past decade (average of 50.8%). In the fall, sex identification of juvenile turkeys can be challenging to untrained hunters, so it is likely there is a substantial reporting bias where hunters report female harvests when actually they have harvested a juvenile male.

Archery hunters (including crossbow under special permit) continued to contribute a significant portion of the total harvest, accounting for approximately 35.6% of the total fall harvest; spring season archery hunters typically account for 7-8% of the total harvest. A large portion of this archery harvest can likely be attributed to archery deer hunters who are opportunistically harvesting turkeys. The high prevalence of archery harvest during the fall season, and the growth of fall only permits indicate continued growth in demand for fall turkey hunting opportunities.

Hunter participation, weather conditions, and food availability may all influence the fall turkey harvest. Turkey population size, distribution, and particularly poult production and survival during the preceding summer months are factors that also greatly influence fall wild turkey harvest. However, archery deer season hunters appear to be opportunistically harvesting turkeys when the seasons overlap each fall. That said, overall fall hunter participation remains relatively unknown and is generally considered to be low relative to the number of total turkey permit holders. Further, sexing and aging of harvested fall turkeys is hampered by the inexperience or disinterest on the part of cooperating check station operators, many of which collected unusable or incomplete feather samples and inaccurate biological measurements.

Spring 2018 Harvest

The 4 week spring wild turkey hunting season occurred from 30 April – 26 May 2018. A total of 2965 wild turkeys were harvested during the regular spring season, representing the 3rd highest spring harvest total ever. An estimated 19.0% of permitted hunters were successful in harvesting at least one turkey during the spring hunting season. Approximately 5.0% of permitted spring turkey hunters harvested a season limit of 2 bearded wild turkeys. Based on hunter surveys, only about 61% of turkey permit buyers actually hunt during the spring season.

Bearded hens accounted for less than 1% of the total spring 2018 wild turkey harvest. In fact, only 5 total hens were reported during the spring season indicated the potential for some substantial reporting bias, primarily associated with online reporting in all likelihood. Bearded hens have comprised <1% of the total spring wild turkey harvest over the past decade, however there are typically 12-25 hens reported each year. Over 4X more adults (80.5%) were harvested compared to immature males (19.3%). The ratio of adult males to immature males was 4.2; it is likely that the high adult:immature ratio is due to hunter preference but also indicative of strong juvenile recruitment.

In 2018, harvest was highest in Worcester (n = 784), Franklin (n = 441), and Berkshire (n = 299) counties. Suffolk County (4 towns) is nominally within the open zone but is heavily urbanized and many areas are closed to hunting and firearm discharge by local ordinances. Spring turkey hunting season is now open for 4 weeks statewide, except for Nantucket which lacks evidence of wild turkeys and is closed to spring turkey hunting. Generally, western counties are showing reduced spring harvest while eastern counties are showing increasing turkey harvest. Again, the distribution of hunter effort may be greatly influencing this trend, however it is also quite possible that as habitat in western portions of the state are less productive and turkey abundance/turkey hunting interest is declining.

A record proportion of spring turkey hunters (8.8%) harvested turkeys with archery equipment in 2018; archery hunting for wild turkeys and other big game continues to increase in popularity particularly in areas of eastern Massachusetts where many towns and proper-

ties will only allow archery equipment as an acceptable means of take.

Overall, hunting opportunities remain excellent across the state, as the relatively high turkey population statewide continues to offer quality hunting experiences.

2018 Spring Youth Turkey Hunt

The 10th annual mentored youth wild turkey hunt was held on 22 April 2017, on the Saturday immediately preceding the opening date of the spring hunting season. In order to participate, youths (ages 12-17) were required to complete a standardized training program and field exercise (pre-hunt workshop) conducted by participating sportsmen clubs and National Wild Turkey Federation chapters. Youths aged 12-14 were given a special 1-day turkey tag. Youths 15-17 are required to be licensed and obtain a regular turkey permit to be eligible for the mentored youth hunt day.

An estimated 273 youths received permits for the youth turkey hunt day. Youths harvested a total of 66 turkeys (23 immature, 43 adult) on youth day, representing a success rate of approximately 25%. Youth success rates are typically greater than regular spring season hunter success.

Ruffed Grouse

2018 Drumming Surveys

In 2018, 19 of 29 random drumming survey routes established statewide were active and 10 were in constant zero status. All routes were surveyed between 15 April – 5 May. All but one (Route #3 Ashfield) constant zero route occurred in either the Northeast, Southeast, or Central wildlife district.

Overall, the average number of drums heard per stop (ANDS) per route on all random routes statewide in 2018 been stable at 0.08 since 2016, but lower than previous years 2007-2015 (0.20-0.34). The ANDS per route in the Western District in 2018 improved to 0.14 and was similar to 2017 on Connecticut Valley district routes. ANDS was also slightly lower on Central District routes (0.06) in 2018 compared to 2017 (0.13). Several constant zero routes were surveyed in the Northeast and Southeast Districts, however no grouse were heard on any of those routes.

The ANDS per route for subjective routes completed statewide in 2017 was 0.41, very similar to recent years (0.42-0.46 from 2014-2017). Grouse continue to be detected on a subjective route in the Southeast District (Route 41) and a new Subjective route in the Northeast District (Route 49, Ashby). Grouse are not widespread in these districts but can be locally abundant in areas with suitable habitat. These subjective routes demonstrate the potential for much higher grouse abundance across the state where forest management can improve the abundance of young forest habitat.

American Woodcock

Woodcock Singing-Ground Survey

Currently, there are 19 randomized singing-ground survey routes in Massachusetts. Of those 13 were active in 2018. The average number of woodcock heard peenting per route (including constant zero routes) in 2018 was 1.22, below the long term 10 year average of 1.60. On the 13 active surveyed routes, a total of 22 woodcock were heard peenting, or 1.83 per non-constant zero route.

USFWS estimates harvest for woodcock through the Harvest Information Program (HIP). A sharp increase in hunter numbers and number of woodcock bagged occurred in 2011 coinciding with a 50% season length expansion. However, the estimated number of hunters and harvest has variable but slightly increasing 2012-2017 (approximately 1020 hunters and harvest of 2100).

New England Cottontail/Eastern Cottontail

Pellet Surveys and Trapping

DNA analyses were conducted on sample 499 pellet samples collected on >50 sites across areas of Barnstable, Plymouth, and Berkshire counties. All plots were surveyed from early January through April 2018. Plots were surveyed 1-3 times. Results of the 2018 winter sampling period are still pending.

Live trapping of rabbits occurred at several properties on Cape Cod. Live trapping of rabbits occurred during January-February 2018. Several adult New England cottontail were trapped and successfully transported to Roger Williams Park Zoo for inclusion in regional captive breeding efforts to enhance and augment imperiled cottontail populations in Maine, New Hampshire, and Rhode Island.

Waterfowl Program
H W Heusmann, Waterfowl Program Leader

Wood duck
Division personnel conducted nest-box checks on 50 study sites used to monitor wood duck populations across the state. The winter of 2016-17 was relatively mild and February was one of the warmest on record. Wood ducks and hooded mergansers began nesting earlier than normal. However, similar to last year, the first week of April was unusually cold and pre-incubated eggs hooded merganser and wood ducks eggs were subject to addling by freezing and cold temperatures. Some clutches with a few eggs laid after the freeze hatched leaving many addled eggs behind. Eggs were left with longitudinal crack indicative of freezing. Some entire clutches were abandoned.

Wood duck nesting attempts were similar to last year with 274 starts compared to 275 in 2016, but below the 297 in 2014 and 321 in 2013. There were 217 hatches compared to 213 hatches last year and 237 in 2014. Hooded mergansers, a species that has increased substantially in the past two decades, were documented with 112 nesting attempts with 88 hatches, similar to last year's 89 hatches. Overall box use was 74% compared to 73% in 2016.

Canada Goose
Massachusetts participates in the Atlantic Flyway Resident-goose Banding Program. The Atlantic Canada Goose Resident Population Management Plan only requires Massachusetts to band 550 geese but we band 800 for the federal database. Geese are captured by roundups during the summer molt, mid-June to mid-July. A total of 798 Canada Geese were banded at 72 sites in 66 cities and towns in Massachusetts. The state total included 385 goslings and 413 adults. Crews also captured an additional 213 previously banded geese.

Pre-season Banding
The 2017 airboating was favorable when precipitation improved after 3 years of below normal rainfall and drought conditions. We were able to boat 13 sites in 17 nights compared to only 9 nights of boating 8 sites in 2016. We ended up banding 773 birds by airboating nightlighting and banded an additional 106 mallards by use of a tub launcher at 10 sites where ducks were being fed for a total of 879 birds. Among birds banded, there were 607 Wood Ducks, 247 Mallards, 16 Green-winged Teal, 1 blue-winged teal, 3 hooded merganser, and 5 Soras. Twenty-four previously banded ducks were also recaptured.

Black duck banding
Postseason banding of wintering Black Ducks continued as part of an experiment to determine if two-season Black Duck banding efforts can improve the precision for Black Duck survival rates. Also of interest was the increase in the black duck bag limit from 1 to 2 after 35 years. All Mallards and Mallard x Black Duck hybrids could be banded and broken down into five plumage types. Bait-trapping was carried out at 15 coastal sites in 10 towns from the New Hampshire to the Rhode Island borders. Trapping was carried out in January and February 2017. The winter of 2017-18 began with unusually cold weather beginning in mid-December and by early January coastal waters were frozen over. However, by mid-January temperatures moderated and February was the 4th warmest on record. Totals of 408 American Black Ducks, 15 black-plumaged hybrids, 1 intermediate type, 2 Mallard-plumaged hybrid, and 32 Mallards were banded. In addition, there were 103 previously banded birds captured.

Park waterfowl survey
During January 2018 we conducted a park waterfowl survey, an event run every 5 years since 1973. A total of 12,624 mallards, 661 American black ducks and 1,131 Canada geese were counted on 145 sites in 79 municipalities at or associated with sites where people fed waterfowl. The survey period covered 8-26 January. The number of mallards at feeding sites declined since the peak count of over 20,000 in 1993 but was 20% higher than the last count in 2013.

Breeding plot survey
During April and May, we participated in the Northeastern states' waterfowl breeding survey, which is based on sampling randomly selected 1-kilometer-square plots. Massachusetts checked 89 of the 1,329 plots checked in this year's survey. Eleven states participated in the 2018 breeding pair survey for waterfowl. A total of 1,327 plots were surveyed. The population estimate for mallards was 221,110 pairs + 37,959. The estimate for black ducks was 15,063 pairs +8,156; wood ducks, 189,705 pairs + 34,432 and Canada geese, 369,914 pairs + 55,300. Data from this survey is used to set

hunting season regulations tailored to the Atlantic Flyway.

Colonial water bird survey
We continued to band eiders nesting on coastal islands as part of a state-wide nesting eider census coordinated with the Colonial Water bird Survey conducted every 10 years. 70 eiders were banded on 6 islands from Cape Ann to Buzzards Bay. Seven previously banded eiders were also recaptured.

Permits
Massachusetts issues individual egg-addling permits for resident Canada goose control under a federal program begun in March 2007. In 2017, we issued 60 such permits, all of which were returned. The permittees reported addling 1,423 eggs in 300 nests, while USDA/APHIS Wildlife Services addled 723 eggs in 136 nests under their statewide permit.

Waterfowl hunting
During the period of September 5-22, Massachusetts conducted a state-wide resident Canada goose hunting season, with a daily bag of seven. Duck-hunting seasons in the Atlantic Flyway continued with the liberal option of 60-day seasons and a six-bird bag limit. The Canada Goose season was 60 days with a three-bird daily bag limit in the Central and Coastal waterfowl hunting zones as we have moved into the moderate hunting season package for North Atlantic Population (NAP) geese and 50 days with a three-bird bag limit in the Berkshire zone for Atlantic Population (AP) geese.

During the period January 20–February 5, 2018, Massachusetts held a late, resident Canada Goose season in the Central Zone and one in the North Coastal Zone January 27-February 15 with a five-bird daily bag in each zone.

H Heusmann, Waterfowl Project Leader attended the Atlantic Flyway Council technical and council meeting in Annapolis, Maryland August 2017 and the Technical Section meeting of the Atlantic Flyway Council held in Cape May, New Jersey in February 2018. The project leader was a member on the Wood Duck/Other Dabblers, Black Duck, and Canada goose committees as well as voting representative for Massachusetts.

Bird Conservation Program
Andrew Vitz, State Ornithologist

American Kestrel Project
MassWildlife and partners continued the American Kestrel project that was initiated in 2013 in hopes of reversing their rapid decline in the state. Kestrels nest across the state and are most common in the Connecticut River Valley and other areas with extensive agriculture. The focus of the project is to promote breeding productivity by deploying and monitoring nest boxes to document breeding success. Collaborators on this project have increased kestrel nesting opportunities by deploying nest boxes on their properties and include the Massachusetts Audubon Society, Keeping Company with Kestrels, Kestrel Land Trust, MA Department of Transportation, MA Department of Conservation and Recreation, Essex County Ornithological Club, East Quabbin Land Trust, Grafton Land Trust, The 300 Committee, the University of Massachusetts, and a few dedicated individuals.
In 2018, MassWildlife and partners maintained and monitored 162 kestrel nesting boxes. Although we are waiting to get results from a couple collaborators, we documented 32/123 (26%) were used by kestrels for nesting. Nest boxes in cranberry bogs in southeast Massachusetts had a 20% (6/30) occupancy rate (Joanne Mason – Keeping Company with Kestrels), CT Valley boxes had a 33% (10/30) occupancy rate, and 25% (10/40) of boxes in central Massachusetts were occupied by nesting kestrels. As in prior years, occupancy rates remained low in northeastern Massachusetts (3/18) but successful boxes were located at the Strawberry Hill reservation (Ipswich), Newburyport, and an agricultural property in Dracut.
In addition to monitoring nesting success, we banded chicks prior to fledging from boxes. During 2018, 72 nestlings were banded in the state with MassWildlife staff banding 25 chicks. Licensed kestrel banders Anthony Hill and Joanne Mason banded kestrel chicks in the Connecticut River Valley and southeast Massachusetts, respectively. Kestrels are a species of conservation concern, and we will continue to work with partners to maintain current boxes, install additional boxes in suitable nesting habitat, and monitor boxes and band young when possible.

Young Forest/Songbird Project
We initiated a project to examine the bird community using young forest habitat created through forestry practices during the nesting and post-fledging periods. Five young forest sites created through forestry were

selected for the pilot project in 2017. All sites were located in Worcester County and were at least 5 acres in size. Three sites were owned by the city of Worcester and two sites were on private land. At each site, 9 mist-nets were established and all nets were separated by > 20 meters. Sampling occurred six times at each site between June 27 – August 16, with nets opened 30 by sunrise and closed four hours later. All captured birds were extracted from the net, banded (except hummingbirds), and data was collected including the bird's age, sex, morphological measurements, and mass. These data will provide information on the species composition and abundance at each site as well as providing an index of the nesting success in the area (taking a ratio young-of-the-year/ adult birds).

In total, 1,331 individuals of 53 species were captured with the most commonly captured species being Gray Catbird (345), Common Yellowthroat (108), Cedar Waxwing (91), Baltimore Oriole (76), and Chestnut-sided Warbler (69). In general, an impressive diversity of early and late successional species were documented using the young forest patches, and this habitat may be especially important to birds during the post-fledging period. Interestingly, the two sites with the most habitat fragmentation in the immediate landscape had the highest capture rates but were dominated by more common species. For instance, captures at these sites included over two-thirds of the project captures for Baltimore Oriole (87%), Ruby-throated Hummingbird (82%), American Robin (78%), American Goldfinch (73%), Gray Catbird (70%), and Cedar Waxwing (67%). On the other hand, the three sites in the most heavily forested landscapes provided a disproportionate percentage of captures of Prairie Warbler (100%), Ovenbirds (85%), and Scarlet Tanager (71%). The overall goal is to establish a long-term project that monitors forest songbird populations in the state while providing information on nesting productivity and how local and landscape level variables influence bird use of these habitats.

Colonial Water bird Survey

The five year coastal colonial water bird survey was conducted along the entire Massachusetts' coast in May and June of 2018. The survey sought to count as completely and accurately as possible numbers of breeding pairs of target species at all known and historic nesting colonies along the Massachusetts coast. Surveys at most sites used the same methodologies as in the previous Massachusetts survey so that results would be directly comparable. Ground counts were done whenever possible and involved several people walking together and counting nests while covering all areas of suitable habitat. When a boat landing on an island wasn't possible, nests were counted from a boat that slowly circled the island.

In total, survey data were collected at 76 sites. Preliminary results from the survey revealed continued declines for the Herring and Great Black-backed Gull, Snowy Egret, Black-crowned Night Heron, and Glossy Ibis and increases for Laughing Gull, Double-crested Cormorant, and Great Egret. In total, we documented 6,287 Herring Gull nests at 49 sites, 3,657 Great Black-backed Gull nests at 46 sites, 3,272 Laughing Gull nests at 1 site (South Monomer), 451 Great Egret nests at 15 sites, 308 Snowy Egret nests at 10 sites, 558 Black-crowned night Heron nests at 14 sites, and 58 Glossy Ibis nests at 5 sites. The most important gull nesting islands included Pekinese and North Monomer Islands while the most important wading bird nesting locations included those as well as Kettle and Children's Islands. These data will be finalized, compared to historical data for each species, and downloaded to a regional database to best support state-wide and regional management and conservation efforts for these species.

Black Bear Program
Dave Wattles, Black Bear Program Leader

Black Bear Distribution and Harvest Investigations

A near record total of 15,071 bear-hunting permits were issued for the 2017 hunting season. A total of 270 bears were taken during the 48-day season, including 151 during the 17-day September segment, 26 during the 18-day November segment, and 93 during the 12-day deer shotgun season segment. One hundred fifty three males, 113 females and 4 unknown were taken in Berkshire (n=119), Franklin (n=64), Hampden (n=38), Hampshire (n=40), and Worcester (n=9) counties. Seventy percent of bears were reported through the online system in 2017, compared to 76% in 2016, 66% in 2015, 74% in 2014, and 69% in 2013. Results from the 2017 Annual Hunter Survey showed that 29% of respondents reported that they purchased a bear hunting permit in 2017 and 22.7% reported they hunted bear during the 2017 season. Of hunters that reported hunting bear, 66.4% did so while hunting other game and 33.6% specifically targeted bear. Thirty seven percent of bear hunters hunted during the September

bear only season, 62% of bear hunters hunted in the November season, which overlaps with deer archery season, and 80.2% of bear hunters hunted during the shotgun season, with only 4.4% of those hunters only targeting bear. There were 54 additional confirmed mortalities in CY 2017. These mortality records are collected by Massachusetts Division of Fisheries and Wildlife staff and through Environmental Police call logs and included: 42 road-kills; 4 bear taken under M.G.L. Ch. 131, Sec. 37; 2 euthanized due to injuries; 1 LART response; and 6 of unknown causes. MassWildlife received 241 bear calls and the Massachusetts Environmental Police received 300 bear calls.

A proposal to open bear hunting statewide and allow bear hunting during the shotgun deer season was approved by the Fisheries and Wildlife Board in 2014 and became effective for the 2015 bear season. Ninety three bears were harvested during the new deer shotgun season in 2017 (47 in 2016 and 59 in 2015).

Black Bear Research

The Massachusetts Division of Fisheries and Wildlife continues to monitor collared female black bears as part of a cooperative research project with the Massachusetts Cooperative Fish and Wildlife Research Unit and the University of Massachusetts Amherst. The primary objectives of this research project are as follows: (1) to refine the population model for evaluating population trends of bears in Massachusetts; (2) to document black bear habitat use and movements in a fragmented landscape and to determine the effects of human-associated food sources on bears, (3) to assess the public's attitudes and perceptions of the bear population and bear management options, (4) to develop a comprehensive bear management plan to guide black bear management in Massachusetts. As of June 30, 2018, 17 female bears were being monitored with GPS collars and another 12 females with VHF collars. To date, 51 female bears have been monitored with GPS collars, of which most have been monitored for at least 2 reproductive seasons. Additionally, 4 male bears have been monitored with GPS collars. In 2017 we began collaring bears in our Western Wildlife Management District. MassWildlife monitored cub production/yearling survival at all successful winter dens or through encounters with sows/yearlings.

Furbearer Program

Dave Wattles, Furbearer Program Leader

Overview

The Furbearer Program is responsible for the management and research of 14 species of wildlife in the Commonwealth. The group of species called furbearers includes beaver, muskrat, bobcat, eastern coyote, red and gray fox, river otter, fisher, striped skunk, mink, long-tailed and short-tailed weasel, raccoon, and opossum.

Massachusetts' furbearers are abundant and widely distributed throughout the state. The populations of these species are scientifically managed and are secure. None are listed as Threatened or Endangered. The value of the Commonwealth's furbearer resource is very diverse and includes economic, ecological, cultural, biological, aesthetic, and educational opportunities for individuals in the state.

The Furbearer Management Program presents many challenges to wildlife managers in the state and employs various options, including habitat manipulation, public education, and regulated hunting and trapping as tools in the management of these renewable resources. A combination of techniques is used to control problem animals, regulate wildlife populations, reduce habitat degradation, reduce crop and property damage, and allow a sustainable harvest of renewable furbearer resources.

Harvest and Population

Harvest activities provide recreational and economic opportunities for citizens and households in the state. A total of 1,730 furbearers were tagged at MassWildlife check stations during the 2017-18 season. The harvest (a combination of hunted, trapped, and/or salvaged) of tagged species included 667 beaver, 87 bobcat, 522 coyote, 244 fisher, 45 gray fox, 22 mink, 62 river otter, and 81 red fox. Trapper survey results indicated that a minimum of 59 raccoons, 34 muskrat, 30 skunks, 18 opossum, and 1 weasel were trapped during the 2017-18 season.

Division staff conducted a hunter survey of all license buyers that provided an email address in 2017. Coyote is the most popular furbearer that is hunted. Twenty-three percent of respondents indicated that they hunted coyote, and 38.6% of those respondents specifically targeted coyotes. Six percent of all respondents hunted fox, 4.8% hunted bobcat, 2.2% hunted

raccoon, and 1.0 % hunted opossum. Bobcat, coyote, and fisher sighting questions were added to our annual hunter survey in order to calculate sightability rates by town and wildlife management zone. Results of those data indicate that coyote are common throughout the state, bobcat numbers appear to be increasing and expanding into more developed eastern zones (9, 10, and 11), and fisher appear well adapted to suburban areas, with our highest sighting rates currently occurring in the eastern WMZs.

Regulated trapping is an important component of wildlife management programs. It is the most feasible and effective method to control furbearer population growth. Regulated trapping conducted by a trained and licensed public is used by state wildlife professionals to regulate wildlife populations and can reduce negative effects associated with high wildlife populations and allow for a sustainable use of a valuable natural resource. Regulated trapping allows residents of the state to reduce the expenses associated with the property damage furbearers cause, which can also in turn reduce the need for residents to pay Problem Animal Control (PAC) Agents.

MassWildlife carefully regulates the harvest of furbearing animals. The Commonwealth has complex laws and regulations that govern the activity of trapping. These include mandatory licensing of trappers and trapper training, restrictions on the size of traps and on types of traps, restricted seasons for trapping and areas for trapping, and mandatory regular checking of traps and tagging of traps to identify the owner.

Wetland/Beaver Management

Between 1996 and 2000, the beaver population tripled as a result of a ban on certain types of traps enacted through a referendum in 1996. Complaints about flooding increased. Typical complaints included flooded septic systems, wells, roads, driveways, and railroad tracks. In July 2000, the Massachusetts Legislature passed, and the Governor signed, a new law that modified the restrictions on beaver and muskrat traps to provide relief for people suffering from flooding impacts caused by beaver or muskrat. An emergency permitting system was created at the town level with certain non-emergency permits for specific traps available from the DFW.

Licensed trappers tagged 667 trapped beaver during the 2017-18 trapping season, of which 108 were reported as taken under emergency permits. PAC Agents reported taking 163 beaver outside the trapping season (April 15, 2017 - October 31, 2017) under emergency permits and 84 beaver during the trapping season of which 34 were taken under emergency permit. Licensed trappers reported through the voluntary trapper survey that 690 beaver were taken under the local Board of Health 10-day Emergency Permit, which includes beaver taken outside the season (n=488) and only beaver taken during the season that were not sealed at a MassWildlife check station (n=202). In total, a minimum of 651 beaver were taken outside of the trapping season as nuisance animals. A minimum of 787 beaver were taken under emergency permits (either inside or outside the trapping season) for which conibear traps are legal to use and are the preferred trap type for beaver trapping.

Public education, regulated harvest, and the installation of flow devices are major components of beaver management in Massachusetts. MassWildlife management goals for beaver include managing beaver for their wetland values, regulating beaver populations within available habitat, and minimizing economic damage to public and private property by beaver.

Furbearer Depredation and Damage

MassWildlife personnel responded to complaints about furbearer species causing the loss of domestic livestock and pets. Specific furbearer species causing concern are eastern coyotes, red foxes, gray foxes, fishers, raccoons, and skunks. (See also the “Human-Wildlife Conflict Trends Project” section, below.)

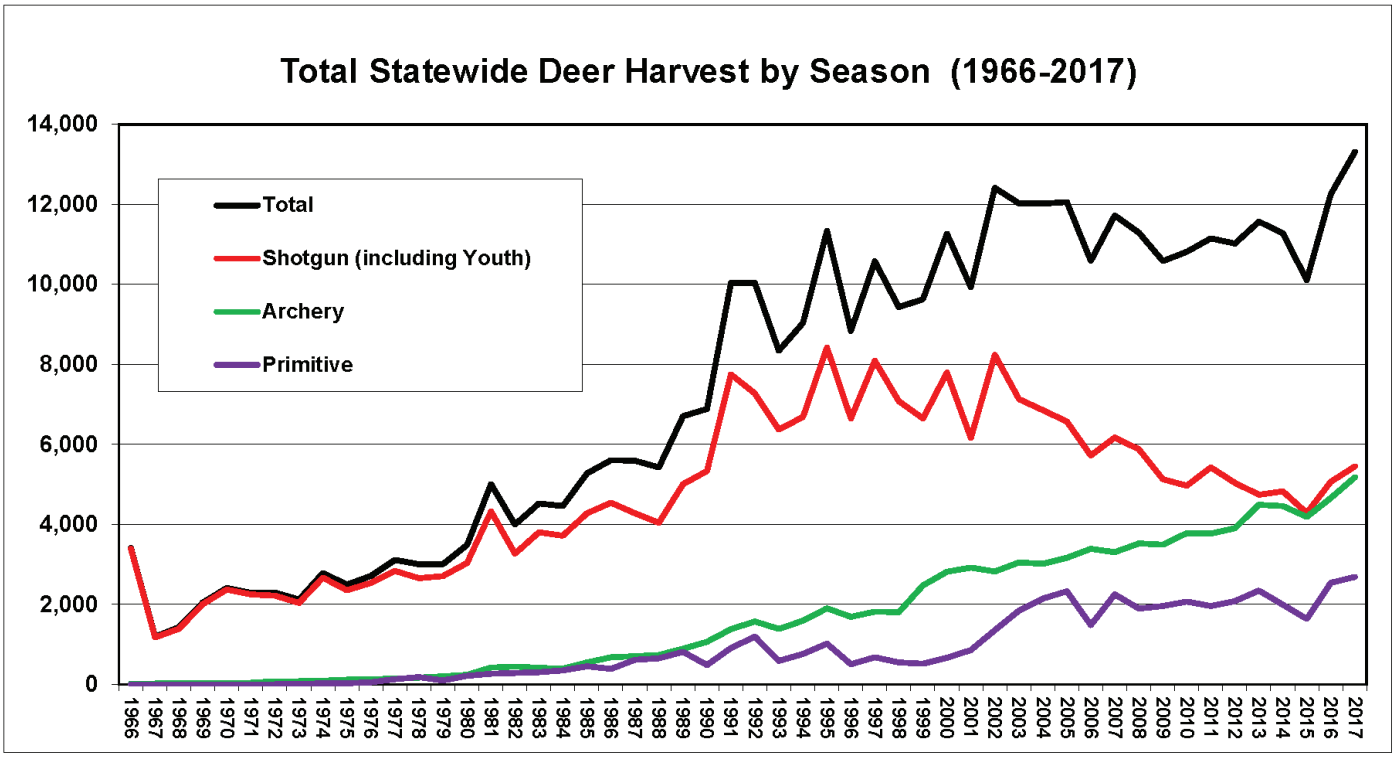
Deer Management Program
David Stainbrook, Deer and Moose Program Leader

Harvest and Population

The statewide 2017 harvest of 13,305 deer represents the highest harvest ever reported in Massachusetts (Fig. 1). The 2017 total harvest was about 9% higher than the 2016 hunting season and 15% higher than the previous 5-year average. The record breaking harvest was attributed to great hunting conditions with snow cover during much of the season and also making up for the low 2015 harvest.

Currently, the deer population statewide is estimated to be over 100,000 deer. Density estimates (from harvest data, so estimates only apply to lands that are

Figure 1. Total white-tailed deer harvest by season and year in Massachusetts.



hunted) range from 12-18 deer per square mile of forest in western and central Massachusetts to over 50 deer per square mile on the islands of Martha's Vineyard and Nantucket and in many suburban Boston areas. Areas with little to no hunting access anywhere in the state can see deer numbers above our estimates. For example, a 2013 non-harvest-based deer survey on the Blue Hills Reservation (over 7,000 acres closed to hunting) near Boston yielded estimates of over 85 deer per square mile of forest.

As in previous years, the Antlerless Deer Permit (ADP) system required a hunter to have an antlerless deer permit to harvest an antlerless deer in any deer season. The ADP system regulates female harvest across all Wildlife Management Zones (WMZ; Fig. 2). Overall, we've met or are very close to our deer density management ranges in the western and central parts of the state (Figs. 2 and 3). However, some areas in the central WMZs appear to be on the lower end of our management range, so antlerless permit allocation has remained at a low level to stabilize or increase numbers, which led to fewer deer being harvested (Fig. 1 and Table 2). Conversely, deer densities in the eastern part of the state are still above our management range, so antlerless permit allocations have

Table 1. The 2017 white-tailed deer harvest by season and sex/age class in Massachusetts, including Quabbin harvest.

Season	Adult Male	Female	Button Buck	Total	Percent Harvest
Paraplegic/ Youth	55	59	7	121	1%
Archery	3,492	1,400	282	5,174	39%
Shotgun	3,109	1,724	490	5,323	40%
Primitive	1,187	1,186	214	2,687	20%
State	7,943	4,369	993	13,305	100%

Table 2. The 2017 white-tailed deer harvest by deer sex/age and the number of antlerless deer permits allocated and issued, by WMZ, for Massachusetts (Quabbin excluded).

WMZ	Adult Male	Female	Button Buck	Total	Population Management	2017 Allocation	2017 Issued
1	249	59	8	316	Increase	400	368
2	493	48	6	547	Increase	175	174
3	437	121	17	575	Increase	1,100	1,045
4N	425	95	19	539	Increase	375	367
4S	299	37	5	341	Increase	275	287
5	478	180	29	687	Increase	1,250	1,231
6	118	39	6	163	Increase	300	294
7	422	245	42	709	Stabilize	2,250	2,177
8	645	282	37	964	Increase	2,500	2,420
9	730	353	66	1,149	Stabilize	4,100	3,766
10	1,223	1,074	251	2,548	Reduce	12,000	11,656
11	1,654	1,041	267	2,962	Reduce	11,000	10,749
12	160	78	16	254	Stabilize	800	810
13	341	387	116	844	Reduce	2,700	1,848
14	244	309	104	657	Reduce	2,700	1,443
Statewide	7,918	4,348	989	13,255		41,925	38,635

remained high in an effort to increase the harvest of females. However, challenges still remain in eastern MA because of the lack of hunter-access, which limits our ability to reduce deer numbers.

The ADP allocation for 2017 was 41,925 permits (the same as in 2016). However, 38,635 permits (92% of allocated) were actually issued in 2017 (Table 2). We determined that the new online system (which started in 2012) and the free convenient way of applying for an antlerless deer permit, led to more hunters applying and fewer returning to play and pay than in previous years. Prior to 2012, we were typically issuing about 95% of the allocated permits in most zones. The decided solution, beginning in 2014, was to adjust the antlerless permit allocation model to compensate for the significant proportion of applicants that do not come back to play and pay and the under-harvest associated with the permit under-issuance.

Research

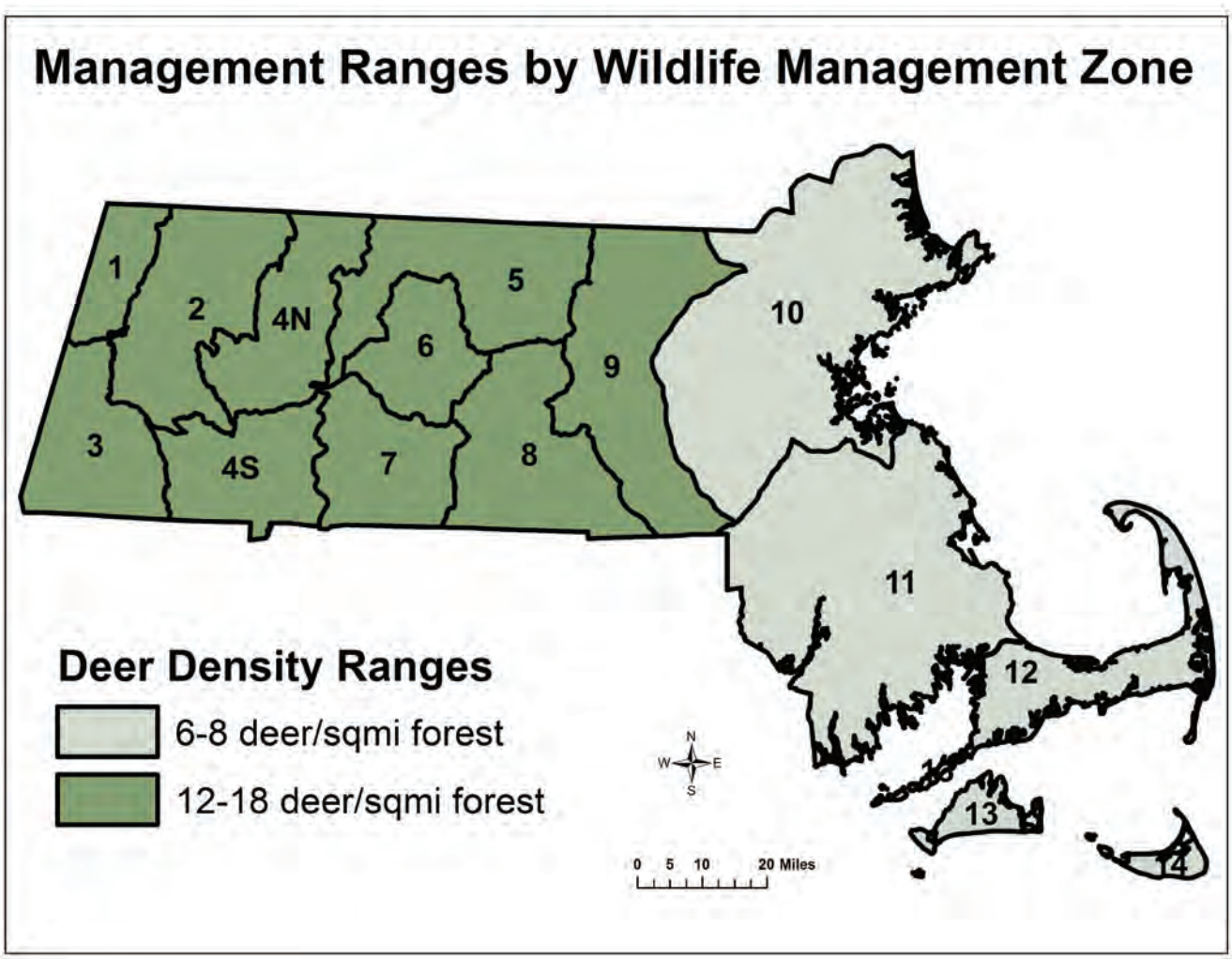
No deer-related research projects occurred in FY 17/18.

Chronic Wasting Disease

Funding provided by the USDA APHIS ceased in early 2012, thus we did not collect or test any hunter harvested deer from MA in 2017. We will continue to sample for CWD from suspect deer provided we can allocate the funds required for testing.


Photo by Bill Byrne/MassWildlife

Figure 2. Map depicting management ranges for the 15 Wildlife Management Zones in Massachusetts, which satisfy the statewide deer management goal of keeping deer densities below the level where major impacts are seen to the habitat, but in balance with social desires/tolerance.

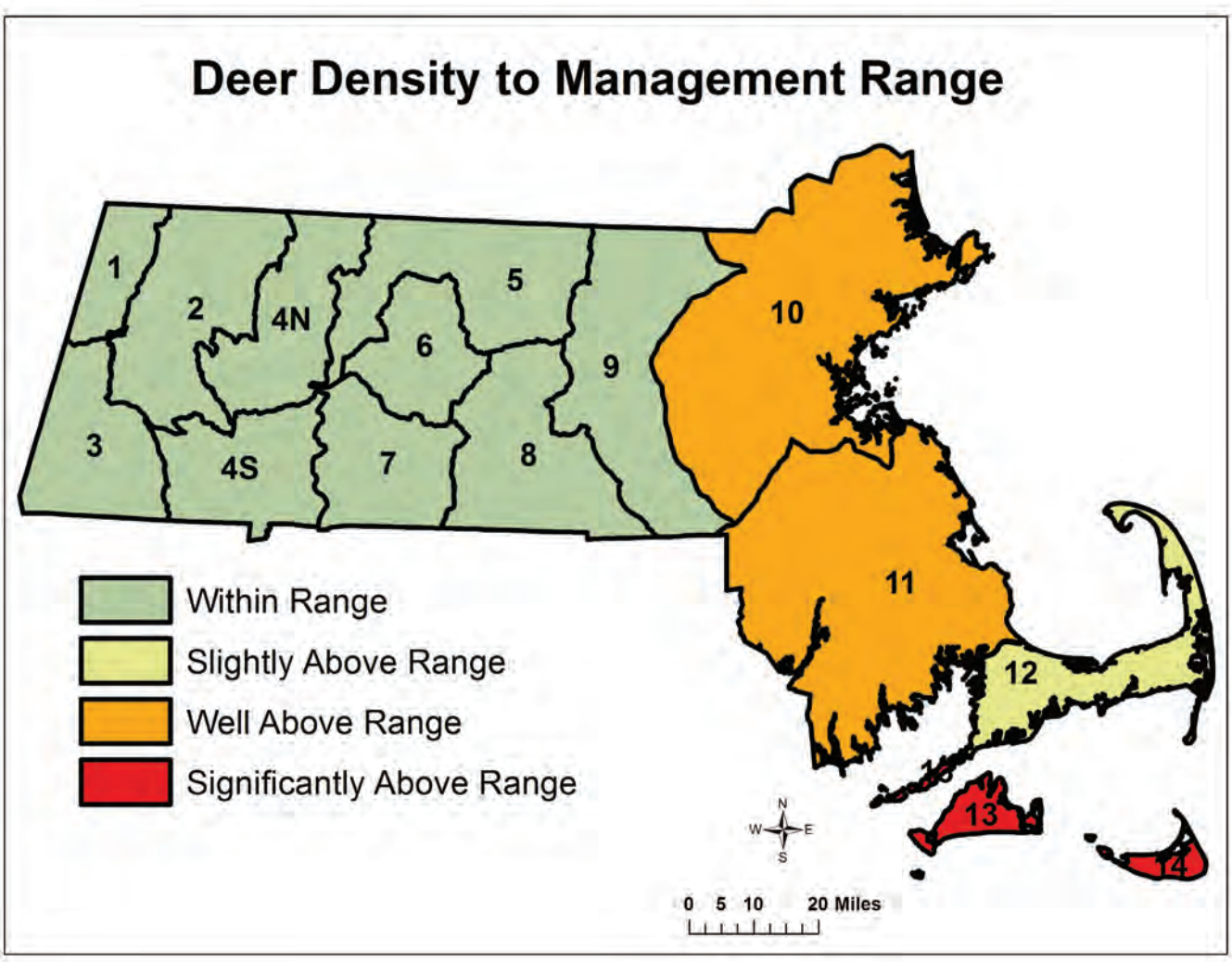


Moose Program
David Stainbrook, Deer and Moose Program Leader

Traditionally, MassWildlife has collected reported data of moose-vehicle accidents (MVA). In 2017, 16 MVAs were reported. However, MVAs are not always reported to MassWildlife or to the MA Environmental Police; thus, these reports make up only a fraction of the actual human-moose interactions that occur in the state. For example, many are discovered indirectly through newspaper reports or verbally from staff that drove by a dead moose along the road. Further, caution must be used when looking at the number of collisions reported from year to year because reporting rates can vary from year to year depending on many factors (e.g., in Fig. 4; reporting rate is likely low in 2007-2009). Nonetheless, these indices can be useful for biologists to use, along with other population trends, to monitor moose relative abundance and trends in Massachusetts. The number of reports per town can be useful when making decisions about areas to focus on with signage on highways (Figure 5).

The current moose population in Massachusetts is estimated to be around 1000 animals. We use a basic population model that incorporates standardized sighting rates from an annual deer hunter survey (we ask a random sample of deer hunters how many moose sightings they had per hour of deer hunting) and available moose habitat in the 12 WMZs that we feel have the potential for moose (we exclude Cape Cod and the Islands in our estimate, as they do not represent potential moose habitat). The hunter observation data can be used to map moose distribution across the state (Fig. 6). The two maps (Figs. 5 & 6) were created from

Figure 3. Map depicting how the current deer densities relate to the management ranges for the 15 Wildlife Management Zones in Massachusetts.



completely independent sources of information, yet show very similar trends, providing more confidence in the methods.

Chronic Wasting Disease

Funding provided by the USDA APHIS ceased in early 2012, thus we did not collect or test any moose in 2017. We will sample for CWD in suspect moose provided we can allocate the funds required for testing.

Human-Wildlife Conflict Trends Project
Susan McCarthy, Wildlife Biologist

Overview

Animal report data are collected at MassWildlife offices via the Massachusetts Division of Fisheries and Wildlife Animal Report Form. The data collected include; date, species, town, and report type (sick or injured animal, aggressive animal, property damage, depredation, etc.). Reports come in the form of phone calls and emails from the general public. Reports are recorded as given by the individual therefore, are not considered accurate with regards to species identification or the circumstances of the incident. In other words, the data collected are meant to represent the public's perception of a conflict or interaction with wildlife. In 2015 we developed a new online data collection system and emphasized the importance of rigorous data collection. The new data collection system gave us the ability to better categorize reports by providing the collector with a set of standard report types from which to choose. Also, we were able to collect data on the type of concern associated with the report. The new system has made data collection and data entry more efficient by first, allowing for multiple reports per page and second, by not requiring the collector to

Figure 4. Total moose-vehicle accidents reported per year from 1980 to 2017 in Massachusetts.

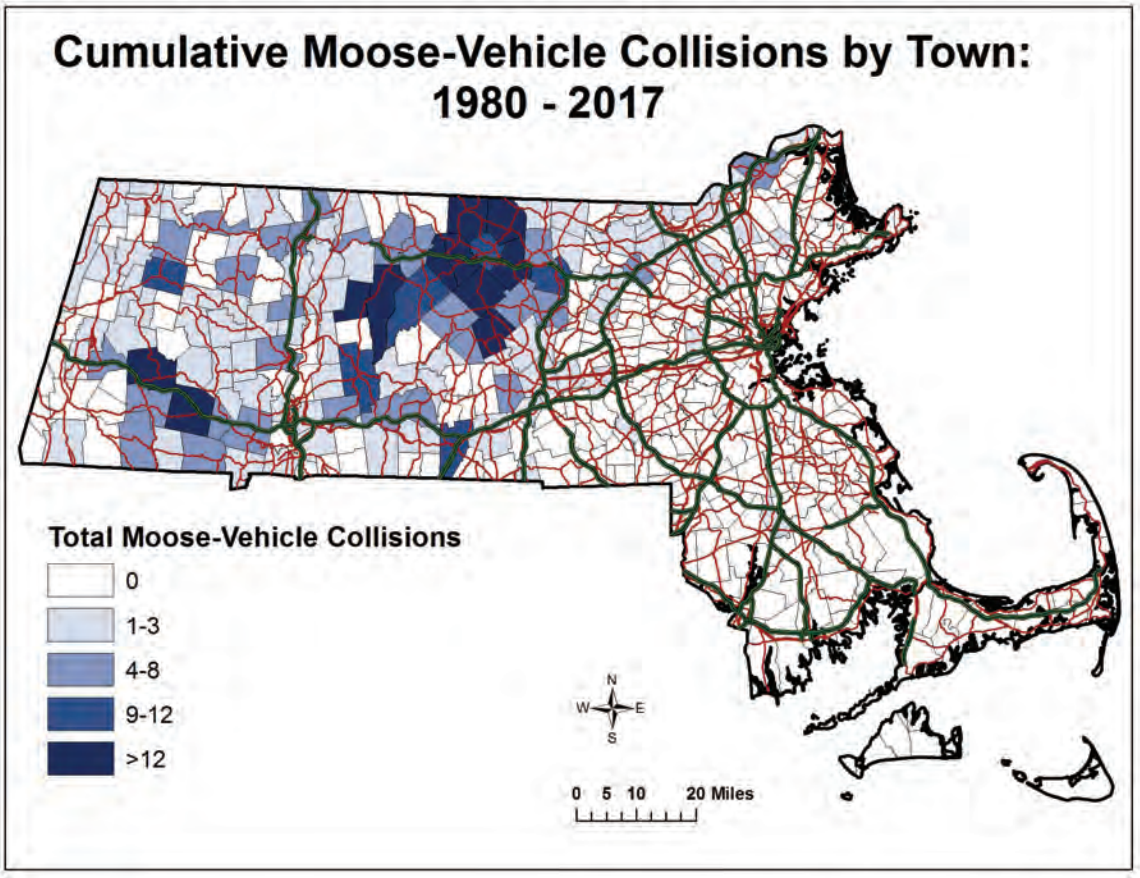


Figure 5. Total number of moose-vehicle accidents reported by town from 1980 to 2017 in Massachusetts.

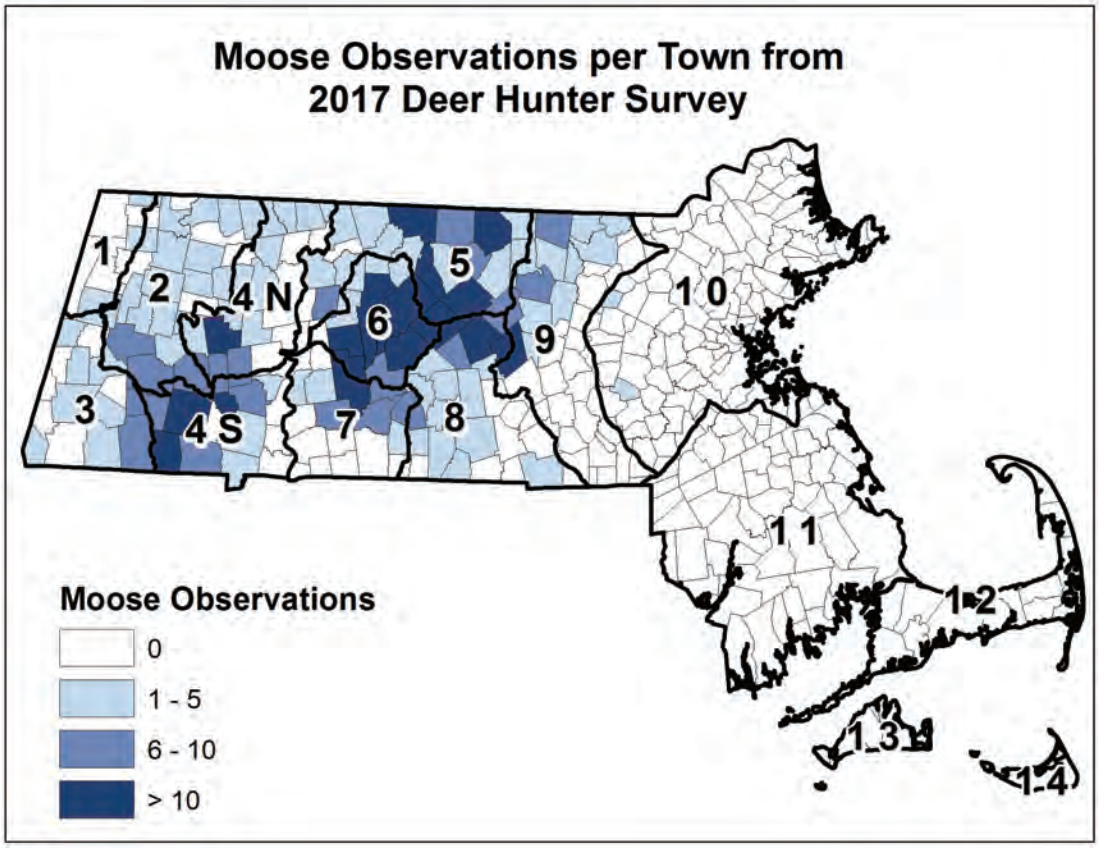
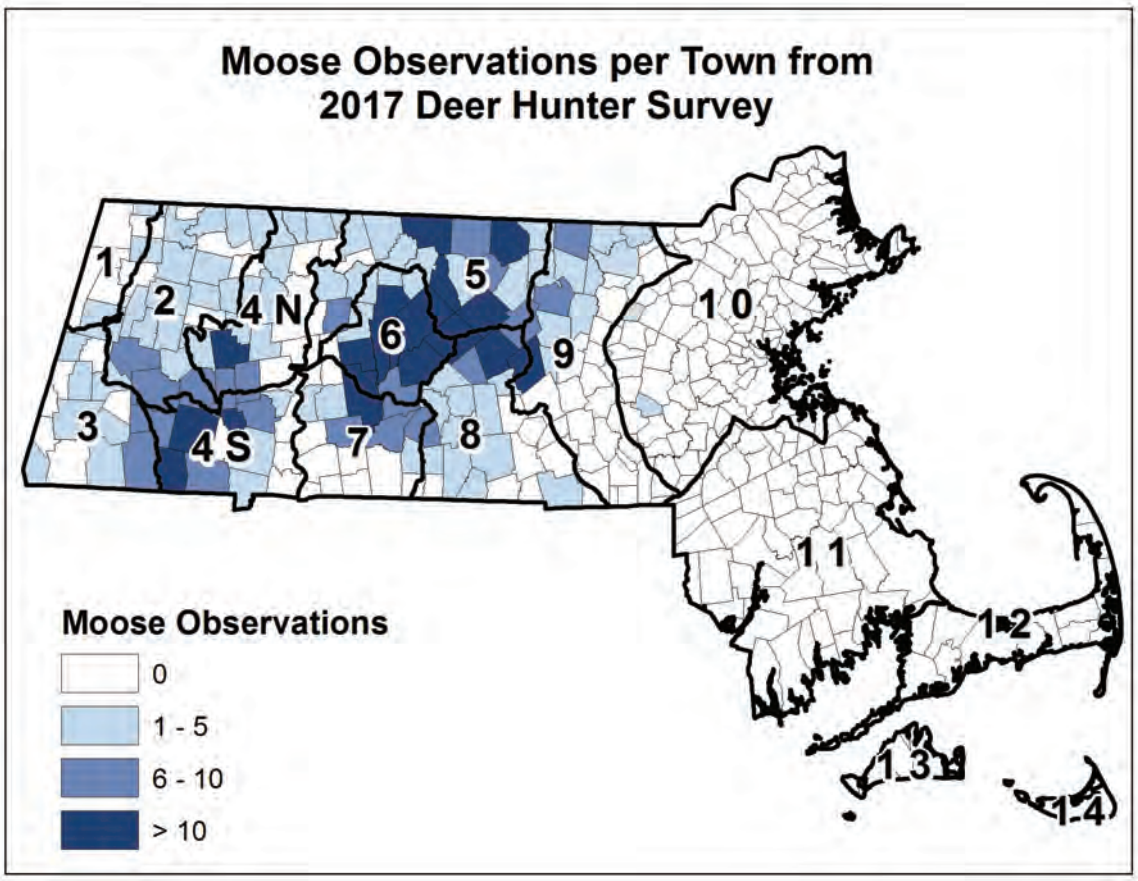


Figure 6. Observations of moose by town reported in the 2017 hunter survey in Massachusetts.



describe the report type therefore, not requiring the enterer to subjectively interpret and categorize the report type. Also, we have emphasized the importance of collecting data for all reports regardless of species, location, report, or concern.

Summaries include, but are not limited to, graphs displaying differences in volume of report type, concern type, species, and season. Maps are developed using Massachusetts Geographic Information Systems (MassGIS) to geographically display the distribution of reports by type and species. These summaries are meant to provide district biologists with information to assist them when providing advice and management options to the general public regarding human-wildlife interactions/conflicts.

The purpose of this study is to produce information that can be used to develop proactive management strategies effective at resolving human-wildlife interactions and, more specifically, human-wildlife conflicts. This is accomplished by analyzing wildlife report data, generated through unsolicited phone calls and emails from the public received at each of the six MassWildlife offices regarding a variety of wildlife-related issues.

Summaries

Via the new system, human-wildlife interactions were recorded in 297 of 351 towns across Massachusetts, amounting to 1,553 total reports submitted from July 2017 to June 2018 (Fig. 1). Ninety-eight percent of records (1,529) contained one or more species (5 reports contained more than one species recorded), 98% (1,517) contained a report type, 97% (1,504) contained a concern type, and 95% (1,469) contained a town.

We received reports of 60 different species, of which 12 made up 76% of all reports (Fig. 2). We received more reports in June (278, 18%) than any other month followed by May (196, 13%), August (180, 12%), and July (173, 11%) (Fig. 3). Of the 1,517 reports containing a report type, the highest number of reports were animal sightings and/or requests for general information (1,004, 59%), the second highest number of reports were of wildlife using and/or damaging property (732, 43%), and the least number of reports were

of pet/livestock depredation (109, 6%). Eight percent (115) of reports were regarding threats to public safety which include; wildlife found inside a dwelling, wildlife approaching humans and/or pets on a leash, aggression toward humans, and human attacks. Of the 115 reports of threats to public safety, 18 were reported as human attacks involving wild turkey (9), coyote (4), fox (2), raccoon (1), and unidentified species (2). It is important to note that these data represent the reporters' perception of an "attack" and that physical contact and resulting injuries sustained by people were not confirmed or documented by MassWildlife staff.

Conclusion

The electronic version of the animal report form accounts for the increased reports due to the ease of entering data via an electronic form. The new animal report form seems to have improved MassWildlife staff's ability to collect more objective and robust data regarding human-wildlife interactions. Capturing more diverse human-wildlife conflict data may be the result of several factors; an increased emphasis on collection effort, the implementation of a new electronic animal report form, an actual increase in conflicts, or a combination of some or all of these things. Regardless, MassWildlife staff has found data collection and data entry to be more efficient due to the new animal report form. Also, the new animal report form has proven effective at capturing more robust and less subjective data. Collecting these types of data, affords us the opportunity to conduct more in depth analyses. In areas where percentage of forest increases, interactions decrease. Understanding the relationship between landscape and interactions can help MassWildlife staff focus management strategies such as education.

Summarizing reports of interactions gives us the power to better inform both the public and MassWildlife biologists. Summary information can also be used to detect trends in interactions both spatially and tempo-

Figure 1.

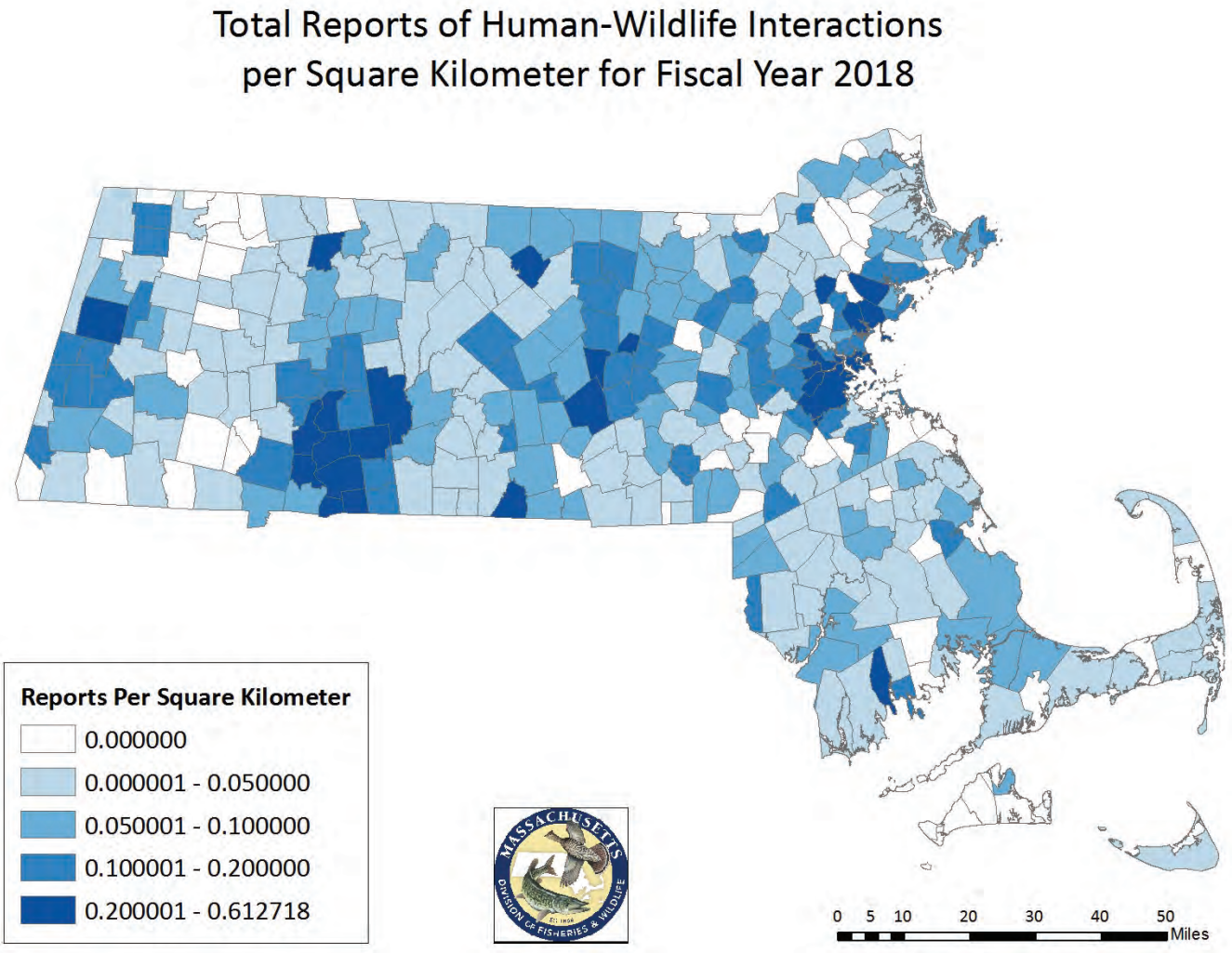


Figure 2.

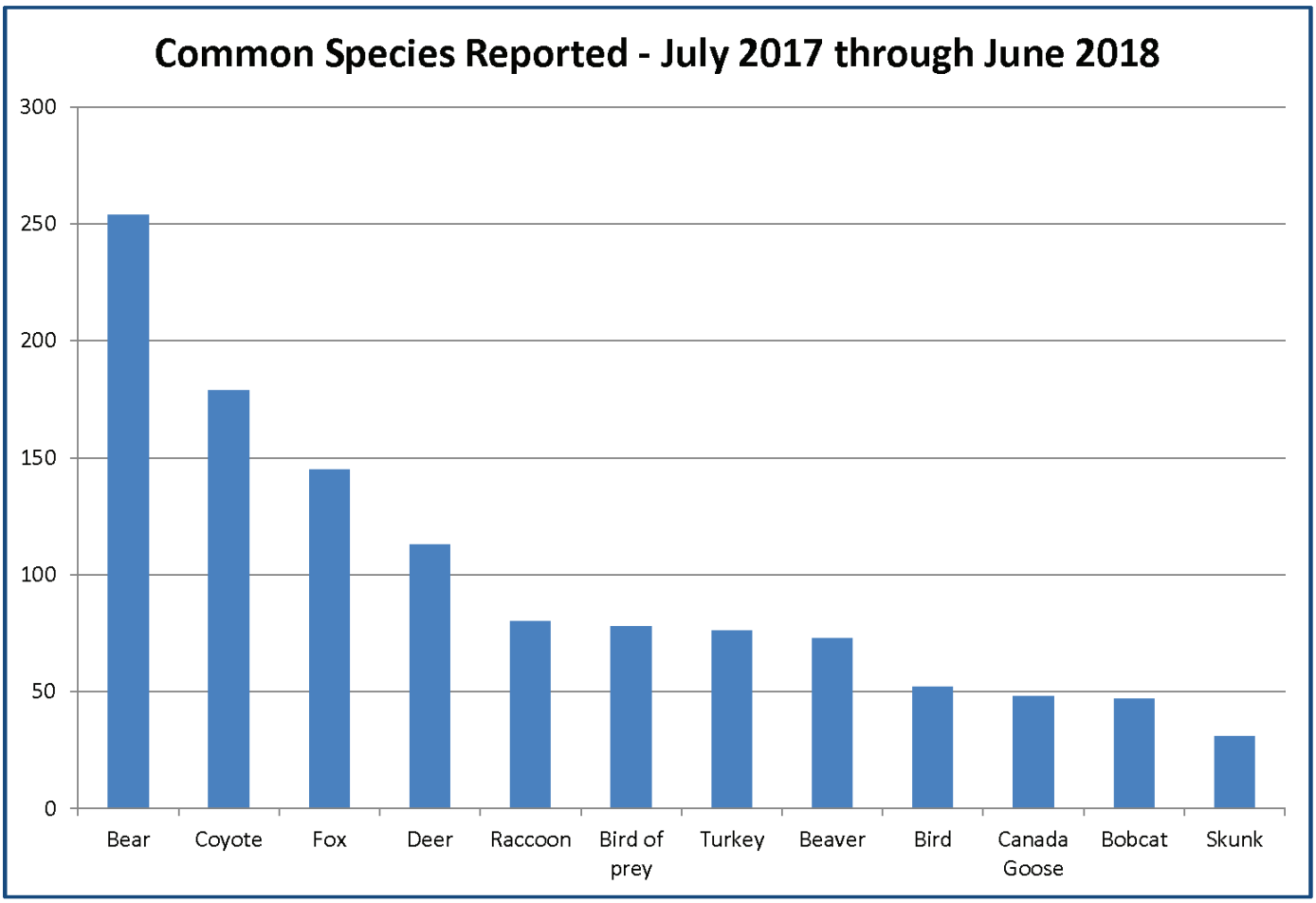
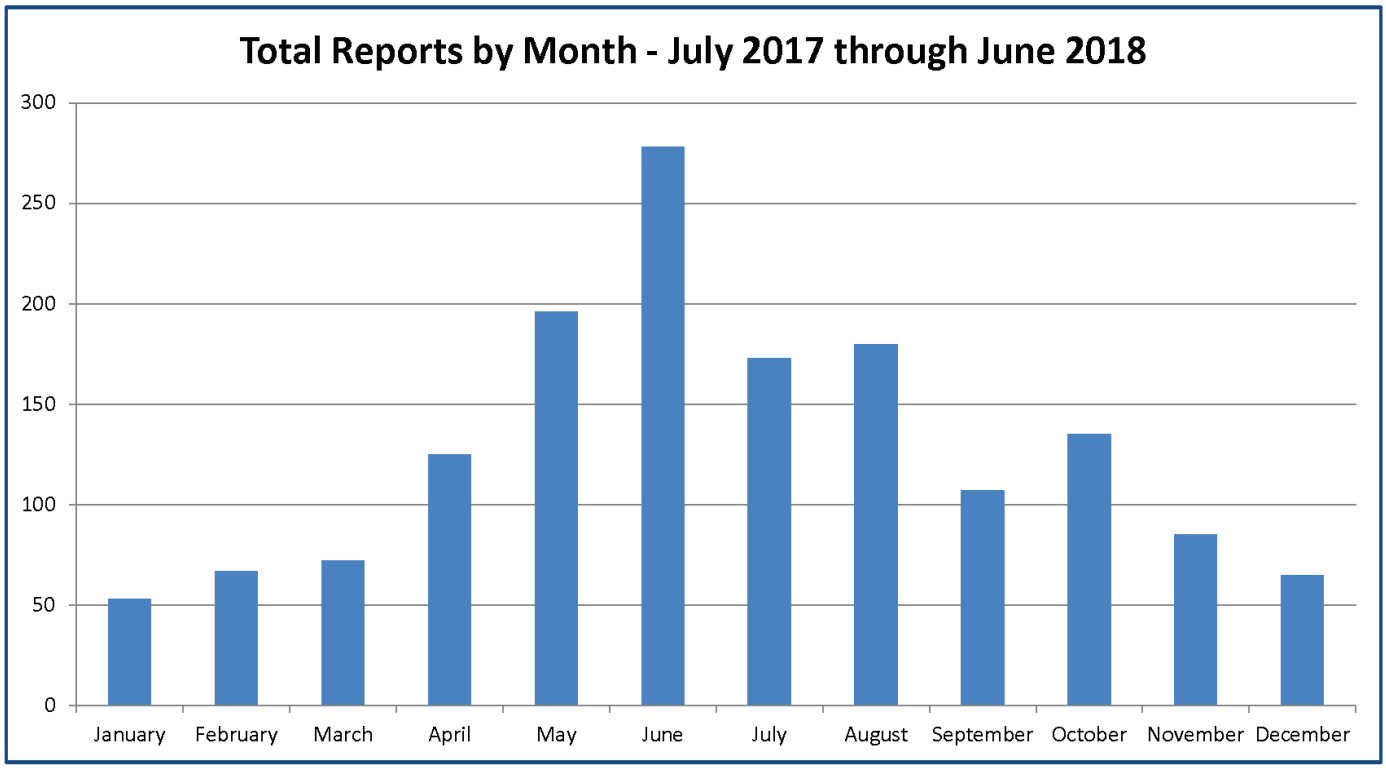


Figure 3.



rally. Total report density across towns has remained relatively consistent over time. In general, major metropolitan areas tend to report more interactions between humans and wildlife than do more rural settings. Also, the proportion of report types is quite similar from last year to this year, and the three most common species remain bear, coyote, and fox.

We can, at the very least, use these data and these results to attempt to predict the occurrence of human-wildlife interactions on both a temporal and spatial scale. Beyond that, we can advise the use of proactive education and intervention at specific times of year and in key areas of the state where a high volume of human-wildlife interactions are likely to occur. Specifically, we will utilize summaries of past years' data to inform Information and Education (I & E) staff on the type(s) of interactions the public should expect. I & E staff can then proactively provide information to the public on the species they can expect to interact with at specific times of year in certain areas of the state. Staff can further proactively educate the public on animal behavior (breeding seasons, feeding preferences, activity cycles, etc.) based on our ability to predict the timing of influxes of specific reports of interactions. It is likely that many of the negative interactions between humans and wildlife reported to our agency are accurate portrayals. That said, it is equally as likely that many of those interactions can be prevented through educating the public on what to expect and how to prevent the interaction (e.g. blocking off denning sites, eliminating food sources, and securing pets).

Landscape Analysis Program
Jonathan Brooks, Wildlife Population Ecologist

The Wildlife Population Ecologist is working with the Biodiversity Initiative group to identify potential sites for conducting young forest habitat management through GIS analysis. A MassWildlife landscape goal is to have 10-15% of all uplands in young forest habitat to support species that are dependent on this environment.

The Wildlife Population Ecologist continues to model fire behavior for prescribed burn plans and fire management plans. GIS data layers are converted into formats that can be utilized in various fire modeling programs used for larger landscape planning. This effort is being conducted and shared with other agencies (DCR, Camp Edwards, Northeast Forest and Fire Management) who participate in MassWildlife prescribed burns. He is also a member of the prescribed burn crew and participates in several burning activities each year as well as training and workshops.

The Wildlife Population Ecologist continues to provide technical and GIS support to all sections within the field office. This includes providing maps for publications such as the 2018 Guide and grant application reviews and submissions. A database has been developed that provides access by numerous agency individuals to assess the status of compliance on habitat project areas.

The Wildlife Population Ecologist assists the Deer and Moose Project Leader by creating transects for annual pellet and vegetation surveys and data for a large regional analysis of deer population densities and harvest.

Permits

Falconry Program
Erik Amati, Wildlife Biologist

Falconry is the act of pursuing game with a bird of prey. Falconry is an activity in Massachusetts that requires a permit from MassWildlife in accordance with 321 CMR 3.04.

In order to first obtain a permit to practice falconry an individual must pass a written examination and have the appropriate facilities and equipment for the proper housing, care of, and training a raptor. Qualified applicants begin as an apprentice falconer and have the opportunity to advance to a general falconer and eventually to a master falconer. Each category requires years of experience and further written and field examinations in order to qualify.

General and master falconers may also obtain both raptor salvage and raptor propagation permits. Raptor salvage permits allow for the taking of sick, injured, or dead raptors. Raptor propagation permits allow for the taking, propagation and possession of all native/or exotic raptors except those species or subspecies judged threatened or endangered unless said species is specifically authorized.

Apprentice falconers are required to capture their bird from the wild whereas general and master falconers are permitted to either capture a bird from the wild or purchase a captive-bred bird.

Only certain species of birds are permitted to possess. As a falconer you are required to train your bird to hunt and are subsequently allowed to eventually release any bird captured from the wild in Massachusetts.

MassWildlife has issued 56 Falconry permits for the 2018 calendar year. Of the 56 permitted falconers -17 hold Master, 27 General, and 12 Apprentice level falconry permits.

Additionally 13 Raptor Salvage permits and 8 Raptor Propagation permits are issued to 15 falconers.

Currently 1 written Apprentice and 1 written General examination have been administered.

Problem Animal Control
Bridgett McAlice, Wildlife Biologist

Problem Animal Control Agents (PAC Agents) are qualified individuals permitted by MassWildlife in accordance with the provisions of M.G.L. c. 131, § 4 and 321 CMR 2.14. The purpose of this program is to provide a mechanism for the public to hire PAC agents to control animals that are causing damage to property or interfering with the reasonable use of such property. PAC agents are authorized to control the following species: snapping turtle, starling, pigeon (rock dove), house (English) sparrow, opossum, moles, bats (except those species listed in 321 CMR 10.90), cottontail rabbits, European rabbit, chipmunk, gray squirrel, red squirrel, flying squirrels, woodchuck, muskrat, rats, mice, voles (except those species listed in 321 CMR 10.90), porcupine, raccoon, weasels (Mustela erminea and M. frenata), red and gray fox, and striped skunk. PAC agents who obtain additional coyote certificate can also take coyotes.

In 2018 251 PAC permits were issued compared to 242 in 2017. MassWidlife administered 24 PAC exams during 2018, which is part of the requirements for obtaining a PAC permit. Of the 251 permits issued, 59 also had a coyote certificate. MassWildlife requires that PAC agents take a coyote certification course in order to obtain a coyote certificate. The coyote certification course is a one-day course and is typically held on an annual basis by our agency.

Wildlife Staff

Westborough Field Headquarters Staff

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Jonathan Brooks, Wildlife Population Ecologist
Fletcher Clark, Habitat Biologist
Patrick Conlin, Private Lands Habitat Biologist
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H Heusmann, Waterfowl Project Leader
Ben Mazzei, Habitat Biologist
Bridgett McAlice, Wildlife Biologist
Sue McCarthy, Wildlife Biologist
Marianne Piché, Habitat Biologist
John Scanlon, Habitat Program Leader
David Scarpitti, Upland Game Project Leader
David Stainbrook, Deer & Moose Project Leader
Andrew Vitz, State Ornithologist
Thomas Wansleben, Habitat Biologist
Dave Wattles, Black Bear & Furbearer Project Leader


Photo by Bill Byrne/MassWildlife

Natural Heritage and Endangered Species Program

Thomas W. French, Ph.D.
Assistant Director, NHESP

Changes to the Massachusetts List of Endangered, Threatened, and Special Concern Species

The Massachusetts Endangered Species Act ("MESA," M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00) require review and updating of the List of Endangered, Threatened, and Special Concern Species ("the MESA list," 321 CMR 10.90) at least once every five years. In practice, the MESA list has typically been updated every 2 to 4 years. There are three main categories of change: (1) listing (addition of a species to the list); (2) delisting (removal of a species from the list); and (3) change in listing status of a species on the list (SC ↔ T ↔ E). Needed changes are proposed on a species-by-species basis. The last update of the MESA list occurred on March 10, 2017. The process leading up to an update of the MESA list involves many steps, and typically takes about a year to complete. The list change process, and associated information, are detailed in the document titled "Listing Endangered Species in Massachusetts: The Basis, Criteria, and Procedure for Listing Endangered, Threatened, and Special Concern Species," available at: https://www.mass.gov/files/documents/2016/08/qd/listing-criteria.pdf.

The process for changes to the MESA list anticipated to occur in 2019 began on November 1, 2017. Between November 2017 and January 2018, staff biologists consulted with outside experts, collated and analyzed data to inform potential list changes, and decided which list changes would be proposed by the Division. Between January and March 2018, staff biologists wrote a total of 15 list change proposals, consisting of seven listing proposals, five delisting proposals, and three proposals for a change in listing status. Three additional proposals to list three bird species were received from the Massachusetts Audubon Society ("MassAudubon"). By March 31, 2018, all 18 proposals had been sent to external reviewers (three or four reviewers for each proposal) for assessment and comments. All external reviews were completed and returned to the Division by May 31, 2018. Staff biologists revised list change proposals, as needed, as a result of comments and other information received from external reviewers.

In June 2018, all list change proposals were presented at a meeting of Division Senior Staff for comment and input. A second meeting was held in June 2018 to resolve any outstanding issues and finalize decisions regarding the Division's recommended changes to the MESA list. It was decided that the Division supported 17 of the list change proposals, including two of the bird listing proposals received from MassAudubon, but did not support MassAudubon's proposal to list the American Kestrel (*Falco sparverius*). The listing process will continue well into FY19.

Linking Landscapes for Massachusetts Wildlife

In 2008, MassWildlife and its NHESP entered into an interagency service agreement (ISA) with the Massachusetts Department of Transportation (MassDOT), Highway Division, to improve the efficiency of state-level environmental project review. This nationally recognized model of cooperation between state agencies has resulted in faster reviews, cost savings, and protection of endangered species and their habitats. As part of the ISA, both agencies agreed to pursue proactive projects to reduce wildlife-vehicle collisions and improve public safety where feasible. Transportation infrastructure affects wildlife through direct mortality due to vehicle collisions and by fragmenting and degrading habitats. In addition, vehicle collisions with wildlife often result in property damage and sometimes personal injury.

In conjunction with the University of Massachusetts, Amherst, the agencies launched Linking Landscapes for Massachusetts Wildlife (LLMW), a long-term and multifaceted volunteer-based monitoring program and planning collaboration to be implemented throughout the state. Utilizing expertise from various state departments, along with collaboration with the public, LLMW's objectives are to: 1) reduce wildlife-vehicle

collisions and improve public safety; 2) enhance, protect, and restore habitats impacted by roads; 3) control invasive species along road rights-of-ways; 4) incorporate conservation priorities into transportation planning; and, 5) implement wildlife and transportation related research.

In 2010, four research projects were developed to collect information through volunteer participation designed to gather information on wildlife mortality along roadways. Three separate databases available on the LLMW website serve as a central location for compiling observations of vernal pool amphibians during spring migration, turtle crossing hotspots, and all other species of wildlife. LLMW has also coordinated a monitoring program for freshwater turtle mortality associated with the nesting season. From 2010 to the end of FY18, over 520 volunteers participated in these projects. They documented over 6,450 mortalities (representing 82 species) at 2,301 locations throughout the state, including mortality for nine currently and formerly state listed salamander and turtle species. In addition we published our "Linking Landscapes for Massachusetts Wildlife: 2010-2017 Road Mortality Summary Report (January 2018, Revised March 2018). This report also synthesized data from MassDOT's Road Mortality and their Crash Portal Data.

In collaboration with MassDOT and the Nature Conservancy, we continued to monitor existing roadway crossings (bridges and culverts) for wildlife use and connectivity. These sites have been assessed using terrestrial connectivity survey protocols and through the deployment of wildlife cameras. Collaboration with the Wildlife Section of the Division and the USGS Cooperative Research Unit at the University of Massachusetts to analyze the movement patterns and use of roadways by black bear and moose continues.

In FY18, LLMW installed 4 collapsible turtle crossing signs in two of the highest risk sites identified by the Northeast Blanding's Turtle Working Group. Linking Landscapes also completed a "Wood and Blanding's Turtle Road Mitigation Report." This report identified road mortality and crossing hot spots using Geographic Information System (GIS)-based habitat and species occurrence models, historical road mortality data, road mortality surveys, site assessments, and expert opinion.

In addition to community engagement through citizen science in FY18, LLMW has installed improved crossing structures and wildlife barriers to enhance public safety and protect endangered species; implemented invasive species control and habitat restoration and species inventory of scenic uplands and calcareous wetlands that are hotspots for biodiversity; engaged with community organizations; installed nesting structures for cliff swallows, a declining species; installed and monitored nine Peregrine Falcon nest boxes on bridges; and maintained a new interactive website. Finally, we are actively planning and preparing for the 2018 Northeast Transportation and Wildlife Conference. MassWildlife and MassDOT are hosting the biannual conference at the University of Massachusetts (September 9-12, 2018).

2017 Field Season Summary
Birds

Piping Plover; Federally Threatened
Observers reported breeding pairs of Piping Plovers present at 147 sites; 180 additional sites were surveyed at least once, but no breeding pairs were detected. The population increased 1.4% relative to 2016. The Index Count (statewide census conducted 1-9 June) was 633 pairs, and the Adjusted Total Count (estimated total number of breeding pairs statewide for the entire 2017 breeding season) was 650.5 pairs. A total of 688 chicks were reported fledged in 2017, for an overall productivity of 1.07 fledglings per pair, based on data from 98.4% of pairs.

American Oystercatcher
MassWildlife coordinated annual monitoring and protection efforts for American Oystercatchers conducted by a coastwide network of cooperators. Approximately 200 sites were surveyed during May and early June 2017. Preliminary results indicate that Massachusetts supported an estimated 174 breeding pairs of oystercatchers in 2017.

Terns, Laughing Gulls, and Black Skimmers
Cooperators in Massachusetts surveyed approximately 140 coastal sites in 2017 for the presence of breeding Roseate Terns (*Sterna dougallii*), Common Terns (*Sterna hirundo*), Arctic Terns (*Sterna paradisaea*), Least Terns (*Sternula antillarum*), Laughing Gulls (*Larus atricilla*), and Black Skimmers (*Rhynchops niger*). Compilation of final census results is still underway. Preliminary tallies

include 2,066 pairs of Roseate Terns, 17,204 pairs of Common Terns, 3,091 pairs of Least Terns, 2,751 pairs of Laughing Gulls, 1 pair of Arctic Terns, and 4 pairs of Black Skimmers.

Buzzards Bay Tern Restoration Project

We documented 8,221 pairs of Roseate and Common Terns on Bird, Ram, and Penikese Is. in 2017, essentially the same (-1.0%) as in 2016 (8,301 pairs). These islands supported 2,240 "peak season" pairs of Roseate Terns (vs. 2,050 in 2016; +9.3%), the highest number of Roseate Terns that we have ever recorded nesting in Buzzards Bay, surpassing 2,118 pairs in 2000. The islands supported 5,981 "peak season" pairs of Common Terns (vs. 6,251 in 2016; -4.3%).

Bird Island

Flooding events related to construction issues on Bird I. (see "Bird I. Habitat Restoration," below), affected timing of nesting, abundance, and reproductive performance of terns this year. Both species of tern nested later on Bird than on Ram, a reversal of the typical order, and there were significant decreases in numbers of pairs on Bird. We presume this was mainly because the substrate was saturated and the terns were reluctant to put down eggs; relative lack of nesting material and cover may also have played a role. Common Tern numbers dropped 25% to 1,652 pairs (vs. 2,193 pairs in 2016). Food resources were relatively abundant for Common Terns and productivity was good (1.00 fledglings/nest vs. 0.81), despite some nest flooding. There was an even more drastic drop (48%) in numbers of Roseate Terns (595 vs. 1,153 pairs). Hatching success was atypically low because of widespread flooding of nests, but food was adequate: productivity was 0.60 fledglings/nest and 0.80 fledglings/pair; the latter value excludes pairs whose nests that failed early and probably relaid. Predation was relatively low during most of the nesting season. A vole was found and removed at the beginning of the egg-laying period. After most terns had fledged, an unknown species of raptor was consuming terns at the top of the lighthouse.

Bird Island Habitat Restoration

Construction of the Bird I. Habitat Restoration Project, a partnership between the U. S. Army Corps of Engineers (USACE) – New England District, the Massachusetts Department of Fish & Game – Division of Fisheries & Wildlife, and the Town of Marion, was largely completed in April 2017. The contractor, Cashman Dredging and Marine Contracting Co., LLC, constructed about a third of the revetment during December 2015 – April 2016 and completed the remainder of the revetment, nourishment, and most of the plantings during September 2017 – April 2017. Newly planted vegetation thrived, except where loafing Double-crested Cormorants killed it with their excrement, but unfortunately weedy annuals that came in with the fill thrived as well.

Design modifications that we made after the first construction season – adding a ring of cobble around the island to provide adult terns with a less-vegetated provisioning area for chicks and chinking voids in the revetment with stone to prevent entrapments of Common Terns – functioned as desired; however, there were unexpected issues in other areas. One issue was that fine material in the fill impeded rainwater drainage, causing puddling across a substantial portion of the island. We moved many unoccupied nest boxes from flooded or saturated areas to encourage Roseates to nest in safer areas. A second issue was that there was a deficit of material and certain areas were too low and prone to puddling or tidal overwash.

We are working with the Army Corps and the U.S. Fish & Wildlife Service to resolve these issues before the 2018 nesting season. In September, some of the cobble ring (which fortuitously turned out to be a good reservoir for excess rainwater) was partially reconfigured into narrow (3'-wide) rock-filled drains that extend from the areas with pooling water to the main cobble ring. Two 10'-wide drains near the northwest and northeast points of the cobble ring connect it to the transition stone along the revetment, thereby conducting water off the island. Material excavated to construct the drains was used to elevate some of the low areas. We are currently exploring options to raise the elevation in other fill-deficient areas and cap areas that flooded with highly permeable fill to provide a well-drained surface while the fine-grained portion of the material below wash out over time.

Ram Island

Common Tern numbers on Ram I. were stable at 3,545 pairs (vs. 3,527 in 2016). Food resources were relatively abundant for Common Terns and productivity was very good (1.21 fledglings/nest vs. 0.90). Roseate Terns spurning wet conditions on Bird flocked to Ram, where numbers skyrocketed to 1,555 pairs (vs. 886; +76%).

This is the highest number ever recorded at the site by a wide margin, besting 988 pairs in 2000. Food appeared to be adequate for Roseates and productivity was very good (1.16 fledglings/pair vs. 1.49). The 5,100 total pairs of terns nesting on Ram this year is a new record, surpassing the next highest annual total for the site (4,549 pairs in 2009) by nearly 600 pairs. No major predation events were recorded on Ram this year.

Penikese Island

After a discouraging 2016 due to predation, the situation on Penikese I. completely turned around this year, we presume due mainly to scrupulous efforts to break-up nests of Black-crowned Night Herons, the primary offender last year. Tern refugees from Bird I. apparently buoyed the numbers. Common Terns numbers climbed 48% to 784 pairs (vs. 531 in 2016) and productivity was excellent at 1.85 – 2.16 fledglings/nest (vs. 0.04). Roseate Terns jumped to 90 pairs (vs. 11) and productivity was very good 1.29 fledglings/nest (vs. 0.10). No Arctic Terns nested.

Common Loon

State-wide monitoring of nesting loons was a collaborative effort among staff at the Massachusetts Division of Fisheries and Wildlife (MassWildlife), Massachusetts Department of Conservation and Recreation (DCR), and Biodiversity Research Institute (BRI). Prior to the nesting season, MassWildlife staff deployed nesting rafts at Buckley Dunton Lake (Becket), Cleveland Brook Reservoir (Dalton), Borden Brook Reservoir (Springfield), and Fitchburg Reservoir (Ashby). Rafts also were deployed at the Quabbin and Wachusett Reservoirs (monitored by DCR) and the Pine Hill Reservoir (monitored by city of Worcester). Throughout Massachusetts, waterbodies with suitable loon nesting habitat were surveyed to determine if they were being used by loons during the nesting period. Sites were surveyed by a single observer walking the shoreline and/or by kayak. When a loon was sighted, time was spent watching the bird through binoculars and/or a spotting scope to determine if the bird(s) had any color-bands used to identify individuals. Once territorial loons were found, they were monitored to locate active nests and determine reproductive success.

After an extraordinarily productive 2016 nesting season, loon productivity was down in 2017. The majority of the loon population in the state nest on the Quabbin (20 territorial pairs) and Wachusett Reservoirs (4 territorial pairs). Nests were documented for 17 of the 20 pairs on the Quabbin, and these nests produced 11 hatchlings, with 8 surviving to fledge. On Wachusett Reservoir, nests were documented for all 4 territorial pairs, and these produced at least 4 hatchlings and 2 fledglings. Single pairs of loons (except Mare Meadow

Table 1. Total number of nesting loons and their reproductive success in Massachusetts in 2017.

Site Name	Town	Territorial Pair	Nesting Pair	Chicks Hatched	Chicks Fledged
Bickford Pond	Hubbardston	1	1	2	1
Buckley-Dunton Lake	Becket	1	0	0	0
Crystal Lake	Haverhill	1	1	1	0
Fallbrook Reservoir	Leominster	1	0	0	0
Fitchburg Reservoir	Ashby	1	1	0	0
Haynes Reservoir	Leominster	1	0	0	0
Hycrest Pond	Sterling	1	1	2	2
Mare Meadow Res.	Westminster	2	1	0	0
Moosehorn Pond	Hubbardston	1	0	0	0
Notown Reservoir	Leominster	1	1	0	0
Pine Hill Reservoir	Rutland	1	1	1	1
Quabbin Reservoir	.	20	17	11	8
Springfield Reservoir	Ludlow	1	1	1	1
Stockbridge Bowl	Stockbridge	1	0	0	0
Stodge Meadow	Ashburnham	1	1	2	1
Upper Naukeag	Ashburnham	1	1	0	0
Wachusett Lake	Westminster	1	1	2	0
Wachusett Reservoir	.	4	4	4	2
Wampanoag	Gardner	1	1	2	0
Totals		39	33	28	16

which had 2 pairs) were monitored on 17 waterbodies located on lakes, ponds, and reservoirs primarily in central Massachusetts. In total, nesting was documented at 14 sites, producing at least 28 hatchlings and 16 fledglings (Table 1).

Bald Eagle

During the summer of 2017, there were 68 known territorial pairs of Bald Eagles in Massachusetts. This is 9 more pairs than in 2016. The highest concentrations of eagles were along the Connecticut River (14 territories) and Quabbin Reservoir (12 territories). New nests were documented in Acton, Marshfield, Richmond, and Worcester. Of the 68 documented pairs, at least 35 pairs successfully fledged 54 chicks. Of the 54 known chicks that fledged, 29 (54%) were banded by agency staff. In 2014, 2015, and 2016, there were 48, 53, and 59 documented territorial pairs, respectively, which produced 59, 38, and 67 fledged chicks. Although there was a record high number of territorial pairs documented in Massachusetts in 2017, breeding productivity was relatively low, which may be a result of a cold, stormy spring and higher densities of eagles in the state. This is the 29th year that Bald Eagles have raised young in Massachusetts since their restoration. During these 29 years, at least 704 wild-born chicks are known to have fledged, along with an additional 8 chicks that were captive-born and fostered into wild nests and an additional 18 that were captive-born and directly released.

Our 2017 Spring Nesting Eagle Survey took place on April 7, when agency staff and volunteers checked known eagle territories and explored areas with potential eagle habitat to verify continued use of "old" eagle nests and try to locate "new" nests. In total, 30 volunteers participated in the count to assist MassWildlife staff on the increasingly difficult effort to monitor the state's growing numbers of breeding Bald Eagles. The elevated effort on this day provides much of the information that we gather on the numbers of territorial and nesting Bald Eagles in the state. In addition to the single day count, information on nesting eagles is gathered opportunistically throughout the year.

Peregrine Falcon

During the 2017 nesting season, 42 nesting pairs of Peregrine Falcons were confirmed. Of the 42 nesting pairs this year, 9 were not monitored closely enough to know their outcome. Of the 33 monitored pairs, 8 pairs failed, and 25 pairs successfully fledged at least 56 chicks. 40 chicks were banded (71%) from 15 nests. One banded chick is known to have died after fledging, and a second chick was found injured and later euthanized due to unrepairable shoulder/wing injury. This year was tied with 2016 as the largest number of chicks fledged in a single year to date. This is the 31st year that Peregrine Falcons have raised young in Massachusetts since their restoration. During these 31 years, at least 647 wild-born chicks are known to have fledged.

Grassland Bird Plan

During 2017 we collaborated with the Massachusetts Audubon Society to develop a citizen science based approach to collect data on the abundance of Eastern Meadowlark, Grasshopper Sparrow, and Bobolink at grassland sites selected using aerial imagery in a geographic information system (GIS). This information was made publically available on the internet, and amateur and professional ornithologists signed up to conduct the surveys. During this citizen science effort, each site was surveyed three times between 15 May – 15 June with surveys at the same site were separated by at least 3 days. Surveys were conducted between 5:00-9:30 AM and consisted of a 10 minute passive sampling point count.

In total, 51 people participated in the 1st year of this survey effort, resulting in sampling161 sites within 88 towns throughout Massachusetts. Preliminary results indicated that meadowlarks were the least commonly documented species and were only detected at 7% of sites while Grasshopper Sparrow and Bobolink were detected at 11% and 40% of sites, respectively. Bobolinks are known to be one of the more common grassland nesting birds in Massachusetts, but it was surprising that meadowlarks were detected at fewer sites than the state-threatened Grasshopper Sparrow. This collaborative survey effort will continue in 2018 to further our understanding of grassland bird distribution in Massachusetts.

Marshbirds

We conducted marshbird surveys in the Miller's River Watershed (northern Worcester County) to document the bird community in these wetlands that lack basic bird occurrence data as they are seldom surveyed or explored by the birding community. Sites were selected using a GIS analysis (particularly through ortho-photography, topographical maps and DEP wet-

land data), and each site was ground truthed prior to surveys in order to confirm it provided suitable marshbird habitat. Field survey protocol consisted of visiting each site three times within the survey window of 1 May – 16 June. It has been determined that a minimum of three visits are required to confidently determine presence/absence of target species. Surveys were conducted in the crepuscular hours when marshbirds are most often spontaneously calling, or most likely to respond to playback tapes. Acceptable survey windows are ½ hour prior to sunrise to 4 hours after sunrise, and again 2 hours prior to sunset and ½ after sunset. A great majority of surveys were conducted in the morning hours.

We used the National Marshbird Survey protocol to allow for standardization to other surveys. The National Marsh Bird Monitoring Program provided standardized audio file of the calls of Least Bittern, Virginia Rail, Sora, King Rail, American Bittern, Pied-billed Grebe and Common Gallinule. The format of the file includes an initial 5-minute passive listening period, approximately one-minute of call per target species separated by 30-second blocks of silence between each species call, and a final one-minute post-playback passive listening period.

Table 1. Presence/absence surveys of marshbird species at wetlands in northern Worcester County conducted in May/June of 2017. An "X" indicates that the species was detected at a site for American Bittern (AMBI), Virginia Rail (VIRA), Sora, Pied-billed Grebe (PBGR), and Green Heron (GRHE). No detections were documented for Least Bittern and Common Gallinule.

Site Name	# Points	AMBI	VIRA	SORA	PBGR	GRHE
Ashburnham Wetlands	6	X	X			
Beaver Brook North	6	X				
Beaver Brook South	6		X			X
Birch Hill Wetlands	5	X	X			
Winchendon Bike Trail	6	X				
Eagle Reserve	3		X		X	
Fernald Marsh	1		X			
Gardner Wetlands	4		X			
Otter Creek	5	X	X			X
Lawrence Brook	6	X	X			
Long Pond	4	X	X			
Priest Brook	6	X	X			
Royalston Wetlands	5	X		X		
Stony Brook	5		X			
Spectacle Ponds	5					
Stevens Swamp	1					
Thousand Acre Swamp	4		X			
Templeton Wetlands	6		X			
Winchendon Wetlands	6	X	X			

In total we surveyed 19 wetlands for nesting marshbirds between 1 May – 16 June in northern Worcester County in 2017 (Table 1). The most commonly detected marshbirds were Virginia Rail, which were detected at 14 of the 19 sites. At most sites with Virginia Rails multiple individuals were detected. The only other commonly detected species of marshbird was American Bittern, and they were detected at 10 of the 19 sites. However, in contrast to the Virginia Rail, no more than a single pair of American Bittern was detected at any single site. A single individual Sora was detected in a cattail marsh in Royalston. Pied-billed Grebe was documented nesting at the Eagle Reserve in Royalston in 2016, but only a single individual was documented in our survey effort with no evidence of nesting. Although these surveys do not target Green Heron as this species is more common on the banks of small ponds, we did detect this heron at two of the surveyed sites.

Table 1. Presence/absence surveys of marshbird species at wetlands in northern Worcester County conducted in May/June of 2017. An "X" indicates that the

species was detected at a site for American Bittern (AMBI), Virginia Rail (VIRA), Sora, Pied-billed Grebe (PBGR), and Green Heron (GRHE). No detections were documented for Least Bittern and Common Gallinule.

Eastern Whip-poor-will

In addition to the nightjar surveys the Division coordinates, we initiated a new project to examine movements of Eastern Whip-poor-wills throughout the annual cycle. We captured and placed light-level geolocators on 25 Eastern Whip-poor-wills using a leg-loop harness at two sites in Massachusetts. In total 18 birds were tagged at the Bolton Flats Wildlife Management Area (Lancaster) and 7 at Joint Base Cape Cod (Falmouth). These units record light information at sunrise and sunset to estimate the birds location (to within approximately 150 kilometers). To access these data birds will need to be recaptured the following year and devices will be removed in order to download the data. Eastern-Whip-poor-wills have been found to demonstrate strong site fidelity, and we anticipate recapturing approximately 25% of the originally tagged birds. These data will provide us with information on migratory timing and pathways as well as wintering ground areas. Identifying migratory connectivity will facilitate strategies for developing full life-cycle conservation plans for this species.

Reptiles and Amphibians

Northern Red-bellied Cooter; Federally Endangered

Continuing a major project that has run continuously for 33 years, MassWildlife and its partners made a dedicated effort to locate Northern Red-bellied Cooter (Pseudemys rubriventris) nests at known nesting areas adjacent to Federal Pond in Carver. The first nest was found on June 6th, which is a little later than the typical June 1st start of the nesting season, and the last nest was discovered on July 16th, which is about one day earlier than usual. The entire nesting season lasted 41 days, compared to a normal 47-day window for cooter nesting. The nesting season was affected by a cool and rainy May leading into early June, as well as by a typical problem with fly maggot infestation. A total of 70 nests were identified by John Crane in June and July of 2017. Wire cages were placed over the nests in order to protect them and prevent predation by red foxes, coyotes, raccoons, and skunks. These 70 nests produced a total of 984 eggs (14.06 per nest), which resulted in 833 viable hatchlings (11.9 per nest). Of these, a total of 163 hatchlings were retained for the 2017-2018 headstart program. The remaining live hatchlings were directly released back into Federal Pond.

A total of 123 hatchlings from 2016, plus an additional two hatchlings collected from cranberry processing plants, were headstarted by 28 cooperating schools, organizations, and individuals across Massachusetts. Due to several mortalities, 112 headstarted turtles were released in May 2017 to four separate waterbodies. From 1984 to 2017, a total of 4,168 headstarted Northern Red-bellied Cooters have been released by MassWildlife and partners after nine months of headstarting.

Bog Turtle

We conducted formal population monitoring in May of 2017 in partnership with the Nature Conservancy and a network of trained volunteers at the two known extant bog turtle sites. The Nature Conservancy continued canopy tree removal at the southern site to improve habitat characteristics for the Bog Turtle, under habitat management contract with MassWildlife. At the northern site, three beaver deceiver/flow devices were maintained by MassWildlife Western District staff and NHESP staff, and beaver were trapped at intervals to reduce flooding pressure on sensitive fen habitats. Significant progress has been made managing water levels and controlling invasive plants. Additionally, MassWildlife partnered with state agencies in Connecticut, New York, and other Northeastern states through a Competitive State Wildlife Grant to conduct distributional surveys, nesting area improvements, and habitat management, and participated in regional conservation planning decisions in the summer of 2016 and spring of 2017.

Wood Turtle

MassWildlife continued to work with seven partner states and many non-state partners to develop a conservation plan for wood turtles in the Northeastern United States, funded by a Competitive State Wildlife Grant. MassWildlife is the host agency for this multi-year initiative. As part of this effort, in 2017 our partners completed a major regionwide genetics study that demonstated that wood turtle populations in southeastern Massachusetts and adjacent Rhode Island are among the most genetically distinct in the northeastern States. Additionally, the genetics study provided the basis for establishing population units within a re-

gion-wide Conservation Area Network As part of this regional conservation planning effort, we conducted technical assistance and outreach to key landowners in the Connecticut Valley, Chicopee River watershed, and Merrimack Valley to improve habitat management for wood turtles. Further, in April 2017, we restored a major wood turtle nesting area in the Berkshires in partnership with the Department of Conservation and Recreation, and demonstrated use of the nesting area by at least eight female wood turtles in June 2017.

Eastern Box Turtle

MassWildlife initiated a new partnership to better document the distribution of Eastern Box Turtles in northeastern Massachusetts, where they are known to occur at low densities in association with sandy outwash soils. A single adult male from Cape Ann overwintered successfully in the wild, and thirteen box turtles were found and radiotracked by our partner, Julie Lisk, at a site in northern Middlesex County near the New Hampshire border. MassWildlife also worked closely with the Nature Conservancy to standardize habitat protection efforts for this species supported through mitigation funds for offsite conservation established through MESA Conservation and Management Permits.

Timber Rattlesnake

As of this report, Massachusetts rattlesnake populations have dwindled to five isolated and declining populations. MassWildlife led and managed a multistate effort of Northeastern and Midwestern states, funded by the Competitive State Wildlife Grants program, to assess the population-level effects of an emerging and poorly understood pathogen, *Ophidiomyces ophiodicola* (Snake Fungal Disease or "SFD"). Additionally, MassWildlife initiated formal coordination with New Hampshire Fish and Game, Vermont Fish and Wildlife, and Connecticut Department of Energy & Environmental Protection (the three other New England states with extant rattlesnake populations) to develop and implement a coordinated conservation effort for New England rattlesnake populations and formalize a genetic management plan for the species (funded by the Regional Conservation Needs or RCN program). Further, we established a contract with Tom Tyning, professor at Berkshire Community College, to monitor one of the most threatened rattlesnake populations in Hampden County. MassWildlife continues to coordinate necessary conservation actions, such as trail closures and signage and outreach, through three regional working groups in Berkshire County, Connecticut Valley, and Blue Hills. MassWildlife's proposal to restore rattlesnakes to a protected site in the Quabbin Reservation was reviewed by a working group led by Dr. Joseph Larson.

Copperhead

In 2017, MassWildlife initiated a new population study of copperheads in Hampshire County, and is working with partners to study a population in Norfolk County. MassWildlife continued to partner with MassDOT to remove invasive black swallowwort from an important den and basking area for copperheads in Hampden County.

Eastern Spadefoot

We continued implementation of Year 2 of a 5-year, statewide monitoring plan for Eastern Spadefoot during July–November 2017. As in the previous year, monitors observed peak feeding activity in September and October at a site with good access and collected supplemental information about possible population size, distribution, and wintering phenology. Simultaneously, monitors documented surviving juveniles from a cohort of metamorphs that had been captive-reared and released back to the site following a "tadpole rescue" earlier in the year. Monitors also documented young, juvenile spadefoots at the Sunderland-Hadley site, confirming that there had been successful reproduction somewhere in the vicinity earlier in the year. At the Southwick WMA, we observed 2 juvenile spadefoots during a nocturnal survey, confirming that some portion of the previously introduced eggs, tadpoles, and metamorphs were surviving in the uplands. During August and September, we implemented the first phase of a breeding-pool restoration project at the Wayland site, clearing non-native invasive shrubs and vines (glossy buckthorn, common buckthorn, multiflora rose, oriental bittersweet) by hand and treating stumps with glyphosate. To further reduce shading of the pool, we removed other shrubs, vines, and trees on a selective basis.

During April–June 2018, we began implementation of Year 3 of the statewide monitoring plan with the help of volunteer monitors. The night of April 25th marked the second consecutive year in which spadefoots bred at multiple sites across the state (following the 2014–2016 drought years), and we once again documented breeding activity in/at Westfield, Plum Island, Way-

land, Rehoboth, Taunton, Westport, and Sandy Neck. For the 3rd consecutive year, we visited a historic site in East Longmeadow where a population was suspected to have been extirpated (last spadefoot observation in 1993). Although actual breeding was not confirmed that night, 3 male spadefoots were heard calling from 2 pools not known to have been used in the past (original pool is believed to have been destroyed). Unfortunately, a follow-up survey failed to detect presence of eggs or tadpoles; whether a breeding population persists, or the individuals observed were relics, has yet to be determined. Pools at some sites (Westfield, Rehoboth) failed to hold water a sufficient period of time for metamorphosis, but the Wayland pool was successful in producing metamorphs. Given that the Wayland pool had dried prematurely the previous year, we are encouraged that the habitat restoration work there appears to be paying immediate dividends. At Westfield, we followed the same monitoring and collection protocol as the prior year in support of the population introduction project at the Southwick WMA1. Since the Westfield pool once again dried prematurely in 2018, we translocated ~7,050 tadpoles directly to the Southwick WMA, where successful metamorphosis was confirmed at 2 of 3 pools. We also translocated 600 head-started tadpoles and 121 head-started metamorphs to the WMA. Lastly, we head-started 400 metamorphs for release back to the Westfield site to help mitigate the failure of natural reproduction there. Spadefoots have yet to colonize and breed in the constructed pool in Sunderland (2 seasons post-construction); we will contemplate a small translocation of tadpoles from another pool in the area to facilitate its adoption by the local spadefoot population.

1 See MassWildlife Report Introduction of Eastern Spadefoot to the Southwick Wildlife Management Area: 2018 Progress Report for full details.

Marbled Salamander

During August – November 2017, we conducted approximately 40 surveys (36 dry-pool substrate searches for adults, 4 visual surveys for larvae) at potential breeding wetlands to discover new breeding sites and/or update relatively old records of Marbled Salamander. Surveys yielded observations of the species at 4 wetlands (all via substrate searches), resulting in validation of 1 recently reported discovery of a new population, discovery of 1 new breeding site, and updated records for 2 previously known breeding sites.

Jefferson Salamander / Blue-spotted Salamander Complex

We implemented Year 4 of a recent genetic and morphological investigation into the distribution of the *Ambystoma jeffersonianum* salamander complex in Massachusetts. In this year of the project, we focused on searching for and sampling (or re-sampling) populations of Blue-spotted Salamander in Bristol and Plymouth counties. We sampled 5 study sites (2 historic sites with no genetic data, 2 sites with recent but minimal genetic data, and 1 novel site) during February–April 2018, conducting dozens of trapping surveys (1,565 trap-nights across 17 wetlands) and several cover-object searches. However, an unusually early "false-start" to the breeding season – combined with erratic weather – appeared to impact results, as we captured only 6 new individuals, all from a site sampled in 2016. We collected tissue samples from those salamanders, and the lab results supported an ongoing contention that the region very likely hosts "pure" populations of Blue-spotted Salamander (rare in the Northeast). We have now collected a total of 601 tissue samples among 35 sites over the course of the study, and we plan to publish results in a peer-reviewed journal. The results are expected to provide a major update to what is known about the geographic distributions and genetic lineages of the various members of the salamander complex in Massachusetts, helping to highlight priority populations and areas for conservation. In addition to that study, routine egg-mass surveys conducted for *A. laterale* in April 2018 resulted in updated records at a population, sub-population, and vernal pool where the species had not been documented since 1983, 1979, and 1993, respectively.

Tiger Beetles

Northeastern Beach Tiger Beetle *(Cicindela dorsalis dorsalis)* **Monitoring**

The Northeastern Beach Tiger Beetle is state-listed as Endangered, in addition to its listing as Threatened under the federal Endangered Species Act. Since 1989, annual monitoring of the population of this species on Martha's Vineyard has been conducted by Tim Simmons, with the assistance of other NHESP/DFW staff and occasional volunteers. In 2017, Tim Simmons continued annual monitoring on a contract basis. The estimated total of three sub-populations of Northeastern Beach Tiger Beetle inhabiting three separate stretch-

es of beach/dune habitat on Martha's Vineyard was 2,535 individuals in 2017. This total is the lowest in more than seven years, and the decline has occurred only at the largest of the three subpopulations, which inhabits the beach along the southwest shore of Aquinnah. Although large storm events both destroy and create habitat by erosion and accretion, in recent years available habitat has been shrinking at Aquinnah, and this seems the most likely explanation for the decline of this sub-population. In contrast, the population of Northeastern Beach Tiger Beetle introduced to Monomoy National Wildlife Refuge in the early 2000s continues to thrive, with > 5,000 adults present for the fifth year in a row.

Cobblestone Tiger Beetle *(Cicindela marginipennis)* **surveys**
The Cobblestone Tiger Beetle is listed as Endangered in Massachusetts. It has not been observed at its single known site since 2007, despite surveys conducted there in 2012, 2013, 2014, and 2017. In 2017, an approximately 20 km stretch of the Deerfield River was surveyed for this species by Mike Nelson (NHESP/DFW Invertebrate Zoologist), with a total of 32 cobble bars searched. Despite a substantial amount of apparently suitable habitat along the stretch of the Deerfield surveyed, no Cobblestone Tiger beetles were found.

Puritan Tiger Beetle *(Cicindela puritana)* **Cooperative Recovery Initiative**
Massachusetts Natural Heritage & Endangered Species Program participation in the Cooperative Recovery Initiative (CRI) for the state Endangered, federally Threatened Puritan Tiger Beetle was continued. This project is led by the U.S. Fish & Wildlife Service (USFWS). Captive propagation of beetles at the Silvio O. Conte National Fish & Wildlife Refuge in Sunderland, Massachusetts, produced sufficient larvae for reintroduction at several sites in Connecticut. Although the USFWS no longer considers long-term persistence at the Rainbow Beach site in Massachusetts an explicit recovery goal due to adverse, artificial hydrology over the past decade at this site, "excess" larvae not needed at the Connecticut sites were released at Rainbow Beach in 2017. Summer counts of adult beetles at Rainbow Beach remain precipitously low, and population supplementation may be the only hope for continuous persistence of Puritan Tiger Beetle at Rainbow Beach unless adverse hydrology conditions resulting from operation practices at the Turners Falls Dam. Current practices include daily dam releases from late June through early September, which results in most of the beetle's beach habitat being flooded.

Moths and Butterflies

Hessel's Hairstreak *(Callophrys hesseli)* **surveys**
In 2017, field surveys for Hessel's Hairstreak butterfly, which is state-listed as Special Concern in Massachusetts, were conducted on a volunteer basis by members of the Massachusetts Butterfly Club (MBC). Locality data for 16 sites, each with no record of Hessel's Hairstreak in 20 or more years, was provided to the MBC. Efforts by MBC members did not document any Hessel's Hairstreaks in 2017. While it is possible that Hessel's Hairstreak no longer occurs at some of the sites surveyed, a more likely explanation is that this species is often too difficult to observe at any single site without a multi-year effort. Hessel's Hairstreak butterflies spend most of their time in the tree canopy where they cannot be seen, descending only occasionally (usually during warm, sunny weather) to nectar at flowers. In 2017 there was significantly less warm, sunny weather than an average year during the flight period of Hessel's Hairstreak (May and early June).

Bog Elfin *(Callophrys lanoraieensis)* **surveys**
The Bog Elfin butterfly is listed as Threatened in Massachusetts, with only three known populations in the state. In 2017, one known site and another potential new site for this species were surveyed by Mike Nelson (NHESP/DFW Invertebrate Zoologist). The known site, Blood Swamp in Rutland, was first documented in 2001 and had not been surveyed since. Not only was the Bog Elfin not found at Blood Swamp in 2017, but it was discovered that its larval host plant, Black Spruce (*Picea mariana*) had experienced near complete (>99%) mortality at this site. Based on the condition of the dead trees, subsequent examination of aerial photos taken between 2001 and 2014, and later discovery of beaver dam remains along the stream draining the swamp, it was concluded that the Black Spruce mortality at Blood Swamp was likely the result of severe (deep and long term) flooding by beaver between 2008 and 2013. A potential new site identified by inspection of aerial photography, Hemingway Swamp in Hardwick, was surveyed for Bog Elfin. This species was not found at Hemingway Swamp in 2017 despite the presence of both Black Spruce and nectar sources.

Precious Underwing *(Catocala pretiosa pretiosa)* **surveys**
The Precious Underwing moth is listed as Endangered in Massachusetts, with only three known populations in the state. By far the largest and most geographically widespread of these populations is located in southeastern Plymouth County. Surveys to monitor and document the geographic extent of the southeastern Plymouth County population have been conducted by Mike Nelson (NHESP/MassWildlife Invertebrate Zoologist) since 2002; in 2017 this species was found at a new site approximately 4.5 km from the nearest previously documented site.

Surveys for pine barrens moths at Camp Cachalot and Maple Springs Wildlife Conservation Easements
In 2017, pine barrens moths were surveyed at Camp Cachalot and Maple Springs Wildlife Conservation Easements by Mike Nelson (NHESP/DFW Invertebrate Zoologist), using standard methods (light traps, mercury-vapor light and sheet). A primary target was Buchholz's Gray moth (*Hypomecis buchholzaria*), which is listed as Endangered in Massachusetts, with a single known population in southeastern Plymouth County. This species has been a primary target of moth surveys in this area since 2001. Because of its extreme rarity and spatial and temporal variability of occurrence from year to year, it is found less frequently than other state-listed moth species in southeastern Plymouth County. It was not found in 2017, although other state-listed species were documented in the process.

Plants

Rare Plant Inventory
During the FY17 field season, 71 new rare plant populations were mapped and 288 rare plant populations were updated. The State Botanist and Plant Conservation Biologist searched for, or discovered 169 plant occurrences. Over 500 rare plant observations were reviewed; of these 489 were accepted; 8 were rejected as too little data was submitted for verification, and 9 were kept as leads for the botanists to look at in coming years in the field.

Special Projects
The following actions were accomplished for the three federally-listed plants:

Sandplain Gerardia *(Agalinis acuta)***;** Federally Endangered, State Endangered: Population censuses or sampling procedures were conducted at seven sites, three locations on Martha's Vineyard and four on Cape Cod. The summer was fairly typical on both the Vineyard and the Cape. One of the indigenous populations has not recovered from being mown in 2014 and the drought in 2015, and no plants were observed there this year. Population sizes of this annual plant at the four sites on Martha's Vineyard were 134, 369, and 58, and at the four sites on Cape Cod the numbers were 0, 380, 1726, and 8757.

Small Whorled Pogonia *(Isotria medeoloides)***;** Federally Threatened, State Endangered: In 2016, three new populations of this species were found in the state. In 2017, population censuses were conducted at five of the now eleven known populations, which included a second population in Franklin County. The numbers at the previously known sites were similar to past years. A total of 121 plants were counted at the five surveyed sites, which included 21 plants bearing fruit.

Northeastern Bulrush *(Scirpus ancistrochaetus)***;** Federally Endangered: A survey of the population in Warwick, Franklin County, was conducted, and the plants were observed to be doing well. One day of de novo surveys was also completed but no new populations were found.

General Habitat Management Projects
The Program has put much more emphasis on Habitat Management Projects for rare plants during 2017. In addition, NHESP has worked with USFWS to control swallowwort on the old ski slopes at Mount Tom where the invasive species was impacting a population of another rare plant, Glaucous Sedge (*Carex glaucodea*; E). The Program has also worked with DCR to install deer exclusion fencing in the Blue Hills Reservation to protect the state-Endangered Lesser Snakeroot (*Ageratina aromatica*). This species had not been observed since 2010, but several individuals were observed in flower and fruit in 2017. This area has been heavily browsed by deer, and to protect these plants from browse, two small deer exclosures were installed.

Another site in the Blue Hills Reservation where the Program worked with DCR was near the Neponset River where the state-listed Britton's Violet (*Viola brittoniana*) has been struggling to survive in the midst of a dense stand of the invasive Mugwort (*Artemsia*

vulgaris). The program carefully applied herbicide to Mugwort plants that were out-competing the Britton's Violet and DCR cut and applied herbicide on invasive shrubs nearby.

A new initiative was started around Coastal Plain Ponds in Plymouth. An invasive species of willow, Gray Willow (*Salix cinerea*), has started to invade the shores of these rare communities, and threaten the several rare plants which call this area home. Working with the Town of Plymouth, Gray Willow was cut and herbicide carefully applied to the cut stumps. The willow debris was hauled away from the edge of the pond to dry and die. The first pond for this work was Great South Pond, with additional work planned there and at Boot Pond in 2018.

Invasive Plant Projects

Mile-a-minute vine *(Persicaria perfoliata)* is a relatively new invasive plant in Massachusetts, first documented in 2006. The Massachusetts Invasive Plant Advisory Group has designated this invader an early detection and rapid response species, a priority for management actions. NHESP, in cooperation with The Trustees of Reservations, the DCR, The Department of Agricultural Resources, and the USFWS's Silvio O. Conte National Wildlife Refuge controlled populations of the plant for a fifth year in Erving, Bridgewater, Foxborough and Greenfield. A bio-control weevil has been introduced but does not appear to have slowed the growth or spread of this invasive species.

Hardy Kiwi *(Actinidia arguta)* has been an aggressive invasive species in Lenox MA, causing significant damage to forest canopy and carpeting the forest floor preventing the growth of other plant species. NHESP botanists worked with the Town of Lenox and staff from MassAudubon to control this species in areas of rare plant populations on MassAudubon's Pleasant Valley Sanctuary.

Other Botanical Notes

The State Botanist worked with three interns this past summer searching out rare plant occurrences and submitting the rare plant observations. This group also assisted the USFWS with the re-introduction of Seabeach Amaranth (*Amaranthus pumilus*), a federally-threatened, state historic species. Seedlings were planted on Monomoy National Wildlife Refuge, and will be surveyed in 2018.

Aquatic Species

Aquatic Species Distribution and Status Assessments

During the 2017 field season, NHESP's Aquatic Ecologist conducted surveys for odonates, freshwater mussels, and other rare aquatic taxa in MassWildlife's Western, CT Valley, and Northeast Districts. Surveys included updating or recording new observations of:

Odonates

In 2017 NHESP Biologists recorded over 102 Odonate observations of rare or common species. The majority of these observations are from exuviae, identified to species and have been curated in the NHESP Odonate Collection. These included.

Boyeria grafiana – State Special Concern Ocellated Darner updated at 24 observations at 9 streams.

Gomphus abbreviatus – State Special Concern Spine-crowned Clubtail updated at 5 sites. Evaluation of this species' exuviae suggests that further work needed to distinguish from *G. adelphus*.

Ophiogomphus aspersus – State Special Concern Brook Snaketail updated at 2 sites.

Ophiogomphus carolus – State Threatened Riffle Snaketail updated at 3 sites.

Stylurus scudderi – Formerly listed as Special Concern under MESA, updated at 3 sites.

Stylurus spiniceps – Formerly listed as Special Concern under MESA, updated at 1 site.

Williamsonia fletcheri – State Threatened Ebony Boghaunter, updated at 2 sites.

Mussels

Alasmidonta varicosa – State Endangered Brook Floater presence was updated at 6 sites from three populations. Mark-recapture monitoring was conducted at 2 sites following a dam removal on the Nissitissit River in 2015. Habitat analyses were conducted in cooperation with UMass Cooperative Fish & Wildlife Research Unit (UMass) and the Connecticut River Watershed Council (CRWC) at 4 sites to evaluate habitat needs of Brook

Floater.

Strophitus undulatus – State Special Concern Creeper presence was updated at 8 sites (including 4 new occurrences) in 6 different rivers.

Alasmidonta undulata - State Species of Greatest Conservation Need (SGCN), and a species formerly listed as Special Concern under MESA, Triangle Floater presence was updated at 7 sites in 2 different rivers.

Margaritifera margaritifera – State SGCN Eastern Pearlshell presence was updated at 8 sites (1 new population) in 4 different rivers. Mark-recapture monitoring was conducted at 2 sites following a dam removal on the Nissitissit River in 2015.

Special Projects

NHESP's Aquatic Ecologist continues as the lead coordinator for a multistate, nationally Competitive State Wildlife Grant titled Brook Floater Range Wide Restoration Initiative. Field observations for this project are included above; all other work on this grant will be reported directly through that initiative.

NHESP's Aquatic Ecologist has continued collaboration with UMass, USFWS, and the Connecticut River Conservancy on a statewide competitive grant from the Massachusetts Environmental Trust (MET) on Statewide Restoration of the Brook Floater. The CRC was awarded $40,000, for a second year to support the initiative and invited to apply for year-3 funds (2018). NHESP's Aquatic Ecologist is serving in a technical advisory capacity and assisting in the direction of field surveys.

NHESP's Aquatic Ecologist continues to collaborate on research targeting the feasibility of freshwater mussel propagation, to define methods for population augmentation and reintroduction. In 2017, NHESP's Aquatic Ecologist has served in a technical advisory capacity to UMass and the USFWS at the Cronin Aquatic Resources Center to:

Continue preliminary investigations into feasibility of culture using SGCN species *Lampsilis radiata*.

Assisted in broodstock collection and propagation development for State Endangered *Alasmidonta varicosa*.

Propagation development for State Endangered *Lampsilis cariosa*.

NHESP staff evaluated the effectiveness of *Odonate exuviae* surveys at bridge sites and non-bridge sites, conducting surveys at 15 paired sites across 5 rivers. Six of the 15 sites were surveyed more than once and up to 4 times to evaluate emergence at different periods. These data will be analyzed in FY18 to inform the effectiveness of targeting bridges in exuviae surveys, and in the development of a standard survey protocol for Odonates.

Regulatory Review

The following table summarizes the environmental reviews conducted during FY18:

Review Type	Count
CMP - Application Received	21
Forest Cutting Plan	109
MESA Info. Request/Data Releases	293
MEPA Reviews	52
MESA Project Reviews	576
Notices of Intent	472
Scientific Collection Permits	86
Other	102
Total	1,711

Data Management and Data Products

In FY18, NHESP processed a total of 332 new rare species, natural community, and certified vernal pool records, and updated 1205 existing records. The data processed were in the following categories:

FY18 Totals	New Records	Updates to Existing Records
Vertebrates	53	719
Invertebrates	27	80
Plants	78	379
Communities	0	0
CVPs	174	27
Total	**332**	**1205**

**The NHESP Community Ecologist left the Program 6/30/2016 and no work has been done on the Natural Communities in our database since that time.

Vernal Pool and Rare Species Information System (VPRS)

For the FY18 alone, 172 new people signed up for VPRS, submitting a total of 1815 observation reports, including 187 vernal pool certification forms, 734 plant observation forms, and 894 animal observation forms. Once submitted through VPRS, the information is reviewed by NHESP using standard data acceptance criteria for inclusion in our database, and the accepted records are entered into the database by NHESP Data Staff. In addition to the observation reports submitted through VPRS, NHESP Data Staff processed 5 large reports for Common Loon, Piping Plover, 4 species of MESA-listed terns, and Shortnose Sturgeon.

Land Protection

In FY18, MassWildlife spent about $4.7 million to protect 2,982 acres of land across the state. Several of this year's acquisitions were of particular relevance to protection of rare species and exemplary natural communities, as noted below.

Northeast District

Along a tributary to Unkety Brook in Dunstable, MassWildlife acquired 69 acres, adding to protection of Blanding's Turtles (Threatened) and Wood Turtles (Special Concern) along the brook corridor. Elsewhere in Dunstable, MassWildlife acquired 20 acres of Nashua River frontage from the Town of Dunstable at the mouth of Unkety Brook, adding about another half-mile of protected land along the eastern bank of the river.

Southeast District

In West Bridgewater, MassWildlife added 57 acres to the Hockomock Swamp WMA, protecting more habitat for Threatened Blanding's Turtles. In Halifax, the Division acquired a conservation restriction over 165 acres owned by the Wildlands Trust, on the Winnetuxet River.

Central District

In Hardwick, 32 acres were added to the Muddy Brook WMA in Hemenway Swamp, helping to protect a Spruce-Tamarack Bog, an uncommon type of natural community.

Valley District

Seventy-seven acres of Pitch Pine-Scrub Oak woodland were added to the Montague Plains WMA, helping to protect nine species of rare moths and butterflies, as well as Eastern Whip-poor-will (Special Concern). In Holyoke, 92 acres were added to the East Mountain WMA, where a Circumneutral Rocky Summit natural community and surrounding lands support five Endangered, five Threatened, and four Special Concern species. In Colrain, 126 acres were protected in the Green River valley. Two MESA-listed dragonflies and four MESA-listed plants inhabit this stretch of the Green River.

Western District

At the intersection of Plainfield, Ashfield, and Cummington, an EEOA Landscape Partnership Grant made possible the acquisition by MassWildlife of 466 acres, plus an additional 123 acres of conservation restriction, on the North Branch of the Swift River. This large property protects headwaters for Endangered Lake Chub a short distance downstream.

Natural Heritage and Endangered Species Program Advisory Committee

Full members are: Kathleen Anderson (Chair), Mark Mello (Vice Chair), Thomas Rawinski (Secretary), Gwilym Jones, Joseph Larson, and Wayne Petersen

Associate members are: William Brumback, Andy Finton, Timothy Flanagan, Mark Pokras, Kevin Powers, Dave Small, and Bryan Windmiller

Presentations from Agency Staff

Discussion of when federally listed species should be formally included on the Massachusetts list of Endangered, Threatened, and Special Concern species (Tom French, NHESP Assistant Director; Jon Regosin, Chief of Conservation Science; and Mike Nelson, Invertebrate Zoologist)

An update on the status of the official E, T, and SC species in regulation, including needed revisions to scientific and common names, organization of the list, the species listing process document, and preparations for the next listing review cycle (Tom French, NHESP Assistant Director; Jon Regosin, Chief of Conservation Science; and Mike Nelson, Invertebrate Zoologist)

NHESP Outreach: Where we are and where we're headed (Elaine Brewer, Outreach Specialist)

MassWildlife-Natural Resources Conservation Service habitat management partnership (Marianne Piché, MassWildlife Habitat Biologist)

Coastal Project Reviews within the Commonwealth (Amy Hoenig, Endangered Species Review Biologist)

The Status of Whip-poor-will in Massachusetts (Chris Buelow, NHESP Restoration Ecologist)

MassWildlife Land Protection: Planning and Process (Lynn Harper, Habitat Protection Specialist)

Presentations from Others

State of the Birds 3: Massachusetts Birds and Our Changing Climate (Joan Walsh, Massachusetts Audubon Society)

Terrain Analysis for Conservation (Tim Flanagan, Advisory Committee Associate Member, Berkshire Community College Professor of Environmental and Life Sciences)

Natural Heritage and Endangered Species Program Staff

Thomas W. French, Ph.D., Assistant Director
Tara Boswell, GIS Manager
Elaine Brewer, Outreach Specialist
Chris Buelow, Senior Restoration Ecologist
Caren Caljouw, Prescribed Fire Program Manager (part year)
Melany Cheeseman, Endangered Species Review Assistant (part year)
Karen Dolan, Finance & Projects Administrator
Karro Frost, Conservation Planning Botanist
Rebecca Gendreau, Endangered Species Review Assistant (part year)
Lauren Glorioso, Endangered Species Review Biologist
Lynn Harper, Habitat Protection Specialist
Peter Hazelton, Ph.D., Aquatic Ecologist
Amy Hoenig, Endangered Species Review Biologist
Emily Holt, Senior Endangered Species Review Assistant
Tara Huguenin, Conservation Data Specialist
Michael Jones, Ph.D., State Herpetologist
Jacob Kubel, Conservation Scientist
Michael Lachance, Conservation Data Specialist
Jesse Leddick, Endangered Species Review Biologist (part year), Chief of Regulatory Review (part year)
Jennifer Longsdorf, NHESP Program Coordinator
Lisa MacGillivray, Habitat Mapping Biologist/Data Specialist
Sarah Maier, Natural Heritage Database Manager
Misty-Anne Marold, Senior Endangered Species Review Biologist
Carolyn Mostello, Coastal Waterbird Biologist
Michael Nelson, Ph.D., Invertebrate Zoologist
David Paulson, Senior Endangered Species Review Biologist
Brent Powers, NRCS Review Biologist (part year)
Jonathan Regosin, Ph.D., Chief of Conservation Science
Eve Schlüter, Ph.D., Chief of Regulatory Review (part year)
Amanda Veinotte, NHESP Administrative Coordinator
Amanda Weise, Restoration Ecologist (part year)
Bob Wernerehl, Ph.D., State Botanist
Rebekah Zimmerer, Endangered Species Review Biologist (part year)

The MESA-listed Threatened Eastern Spadefoot toad (Scaphiopus holbrookii).

Information & Education

Marion E. Larson
Chief, Information and Education

Overview

The Information and Education (I&E) Section has the responsibility and challenge of keeping sportsmen, conservation groups, municipal officials, environmental consultants, naturalists and other constituents apprised of regulations, laws, and recreational opportunities related to wildlife. It also provides basic information about and science-based explanations of wildlife-related issues, in order to enhance public understanding of wildlife management and compliance with laws and regulations. The Section also maintains an active program of educational and promotional outreach, to instill and foster public appreciation for fish and wildlife and related conservation and recreation.

Personnel

In February, Jody Simoes hired as the agency's Human Dimensions Project Leader. Though reporting to Administration, he is working in the I & E office space with R3 Coordinator and the Marketing and Outreach Coordinator. He will serve as the specialist for marketing research related to MassWildlife's target audiences and assisting in the development of strategic communication plans. Jody grew up in Gloucester and got his bachelor's degree in environmental science from Unity College. He received his master's degree and PhD from Michigan State University. His master's focus was on Survey Research and Recreational Behavior and his doctorate was on Behavior, Preferences and Segmentation of Outdoor Recreation Markets. Jody worked for the Michigan Department of Natural Resources on Sales Trend Analysis and Marketing Strategies and then served as the Marketing Research Coordinator in Michigan's DNR Marketing and Outreach Division until 2016. He and his family returned to Massachusetts (back on Cape Anne!). Jody served as a Research Associate with the University of Massachusetts and Harvard University. He coordinated the social science team and was responsible for survey development, execution and data analysis.

Sadly, long time Senior Photographer Bill Byrne died unexpectedly in May, 2018. Since 1972, the spectacular photographs taken by MassWildlife Senior Photographer Bill Byrne have brought wildlife enthusiasts and conservationists up close and personal with countless wildlife species from across the Commonwealth. Bill's stunning images ranging from breaching humpback whales, foraging black bears, and secretive piping plovers to urban peregrine falcons, majestic Quabbin moose, and elusive timber rattlesnakes have opened a window to the wilds of Massachusetts and the fascinating residents therein. Bill's images are lasting testimony to his incredible patience, knowledge, and skills. Bill's wildlife legacy will continue through his beautiful images, inspiring and educating us all for years to come.

Communications

Emily Stolarski, Communications Specialist

Website

Website Migration

In late 2016, the Massachusetts Executive Office of Technology Services and Security (EOTSS) announced that all state government web content would migrate to a new content management system powered by Drupal. MassWildlife was identified as an early partner in the migration process since our freshwater fishing web pages are among the most heavily-visited pages of all government content. The bulk of the web pilot pages and web migration work was completed during FY18. The Communications Coordinator worked closely with the DFG web team and with EOTTS to manage the migration. In all, MassWildlife migrated about 650 pages of content. Eight MassWildlife staff members (including 2 from NHESP) worked on the migration. DFG's Web and Social Media Coordinator assisted with tasks related to the migration. In addition, DFG was awarded 2 interns—through a competitive process—to work on the web migration. These interns, who were trained in writing for the web, assisted MassWildlife and DMF in converting pages from the old format to the new Drupal pages.

Staff at MassWildlife used the migration as an opportunity to refresh outdated content and to focus efforts on content viewed most by the public. Best practices for web communication were used including using plain language written at a 6th – 8th grade reading level; breaking up large blocks of text in favor of bulleted lists making it easier for readers to skim and find information; and writing in the first person. The bulk of the migration was completed between June 2017 and January 2018. After this initial migration phase, I&E staff began to fine tune the new product by inserting images and utilizing new web tools. For example, news items can now be displayed with an image on MassWildlife's home page; this feature was leveraged along with existing newsletter delivery tools for a more integrated system. The Communication Coordinator continued to participate in web improvement projects—some as a partner with EOTTS and some independent. They included web analytics dashboard pilot, regulations page pilot, Fishing for Beginners guide, and organization page mosaic.

One of the benefits of the new web content management system is that it is much easier to use. This has allowed regular web maintenance to be parceled out among several staff members. This has freed up time for the Communications Coordinator to take on more web improvement projects and to support marketing efforts. The following is a breakdown of web jobs in the agency.

Position	Web duties
Communications Coordinator	Coordinates all web content including: creation of new content, improving existing content using guidance from analytics; coordinating with the Mass.gov team; attending all Mass.gov trainings and disseminates relevant info to internal web team; coordinating with DFG on various web-based maps and lists (PAC, Rehabber lists, trout stocking, pond maps, etc.); coordinating web content for marketing campaigns, and e-newsletter.
Outreach/Marketing Coordinator	Ensures that web content related to social media posts is accurate and up to date. Ensures that agency events are posted on the web calendar and publicized on Facebook. Updates web content based on feedback from the public. Publishes news stories for the monthly newsletter.
NHESP Administrative Coordinator	In charge of keeping Natural Heritage and Endangered Species Program content up to date.
NHESP Program Coordinator	Publishes MESA Decisions, permits, and applications; NHESP Advisory Committee meeting notices and minutes; Habitat Conservation Plans, HCP Certificates of Inclusion, permits, and annual reports; Updates all wildlife rehabilitation training materials.
Hunter Education Support Specialist	The Hunter Education course schedule change daily and web pages often need to be updated several times per day to reflect course openings and closures. The Hunter Education Support Specialist has access to the registration database and makes timely updates to the schedule when classes are opening or when they close.
Outreach Specialist	Ensures that web content related to Instagram posts is accurate and up to date. Promotes the work of the Natural Heritage and Endangered Species Program and publicizes the NHESP Fund. Publishes news stories for the monthly newsletter.
Federal Aid Coordinator Assistant	The Federal Aid Coordinator Assistant processes the hundreds of Sportfishing Awards Program entries and updates the leader board on the web weekly; publishes contract announcements, calendar events; completes site-wide maintenance as directed; serves as web publishing backup for the agency.
Assistant to the Director	Publishes Fisheries and Wildlife Board meeting notices, agendas, and minutes. These must be published according to the Commonwealth's Open Meeting Law.
Program Coordinator	Maintains MassWildlife CMRs; updates website after a regulation change.

More work is needed to complete the web migration, but we are waiting for EOTTS to build the tools. MassWildlife has 2,425 web documents which were automatically migrated to the new web system. These documents need to be assessed and many will likely need to be deleted. At present there is no way to delete a document. In the coming months, document maintenance will begin.

Website Performance

MassWildlife is able to improve content based on user feedback and usability metrics using new evaluation tools. MassWildlife web pages currently have a score of 93.4% based on content quality, and user experience indicators. The biggest weakness is in the readability category; some pages receive low scores because of sentence length and reading grade level. In some cases, such as regulations, these long sentences and higher grade level reading level cannot be helped. Staff will continue to use all available tools to continue to improve the web-user experience.

MassWildlife E-newsletter and Advisories

Nicole McSweeney, Outreach and Marketing Coordinator, and Communications Coordinator, Emily Stolarski collaborate to publish the monthly e-newsletter called "MassWildlife Monthly." Outreach Specialist Elaine Brewer also contributes an article about the NHESP program to each monthly issue. Twelve issues of the electronic newsletter were published this fiscal year around the first of the month. Over the past year, the number of subscribers receiving the newsletter grew substantially; in July 2017, 26,380 received the newsletter and by June 2018, that number had risen to 41,820. Sign-up tools like a check box to subscribe on MassFishHunt, links to subscribe on the MassWildlife website and social media, as well as signage at fairs and shows have increased the number of subscribers. The newsletter is sent using Constant Contact, an email marketing service. On average, 39% of subscribers open the MassWildlife Monthly email, which is considered an "above industry average" open rate, compared to other businesses and organizations using Constant Contact (18%). Advisories alerting subscribers and license holders of new regulations, special events, public meetings and hearings, etc., were also sent out through Constant Contact.

Agency Emails

Email messages to the agency rose significantly this year for reasons that are not clear. A total of 2,831 (2,068, FY17) agency email messages were managed by Biologist Bridgett McAlice, who is assigned to the Wildlife Section. Summary of emails by month FY 18: July 2017 – 174 emails, August –201, Sept 218, Oct –292, Nov 266, Dec 217, Jan 2018 242, Feb - 236, Mar – 218, Apr – 243, May – 269, June - 267.

MEDIA RELATIONS

Media Inquiries

As per current protocol, media inquiries are routed through the Executive Office of Energy and Environmental Affairs (EEA) press office. Media inquiries are then passed on to MASSWILDLIFE staff for a response. In some cases, EEA provided the information directly (or with assistance from MASSWILDLIFE) to the media, or the inquiry is handled through the Department of Fish and Game (DFG).

In FY 18, the agency received 295 (254 in FY17) media inquiries from 95 (87 in FY 17) different media outlets. Of the 295 inquiries, the vast majority of inquiries still come from newspapers with 167 inquiries (131 in FY17); 79 inquiries came from television (FY 17—69); 37 from radio (27 in FY17); 5 from magazines; and 4 online media sites; 3 free-lance writers, 2 news services (Associated Press, State House News); one watershed association; one film documentary and 2 unidentified outlets.

Print Media Coverage

As in past years, MassWildlife utilized a newspaper-clipping service to collect all articles in Massachusetts newspapers that mention the Division by name. The clipping service reports on print news sources as well as related online outlets. In FY 18, articles mentioning MassWildlife totaled 1847 (1278 print, 569 online) with an average of 154 articles per month. These articles reached 156,198,956 people and are valued at $7,562,314.

Outreach and Marketing

Nicole McSweeney, Outreach and Marketing Coordinator

Social Media

Facebook

In FY 18, MassWildlife continued utilizing its Facebook page (Facebook.com/masswildlife) to engage with its constituents. As the most used social media plat-

form in the world, Facebook has been a useful tool in helping MassWildlife share information about fish and wildlife issues in the Commonwealth; communicate about research projects; promote agency events, programs, job openings, and donation opportunities; listen to what constituents are saying; and engage with the public by responding to their comments and questions. MassWildlife typically posts to its Facebook page daily with a variety of content. By the end of FY 18, the MassWildlife Facebook page had gained over 28,092 followers (up from 20,200 in FY 17, 12,500 in FY 16, and 5,700 in FY 15).

Instagram

MassWildlife initiated an Instagram account (@mass.wildlife) on September 15, 2018. By the end of FY 18, MassWildlife accrued 2,800 followers. Every few months, Instagram invents new ways for accounts to reach their constituents. At every opportunity, MassWildlife uses these additions (such as stories, ask me a question, rating, and carousels).

Videos

I&E staff continue to create and edit video content for the Division. These videos document field work, events, and research conducted by staff. These videos have been utilized on social media, on a display in the MassWildlife Field Headquarters lobby, and by the traditional media. New videos created in FY 18 include topics like Bald Eagle banding, rehabilitated Bald Eagle release, trout stocking, fisheries surveys, song bird surveys, trout spawning, pheasant stocking, pike stocking, anadromous fish passage, and salmon adipose fin clipping.

Agency Visibility

Facility Signage

New facility roadside signs were ordered and installed at each of the hatcheries and district offices (see photo on page 143).

I&E staff worked with Western District Manager Andrew Madden to develop a new sign for Three Mile Pond WMA to highlight the new access for waterfowl hunting, fishing and wildlife viewing created by MassWildlife in partnership with Ducks Unlimited, the Outdoor Heritage Foundation, and OFBA.

MassWildlife worked with DCR, Mass Audubon, MassDOT, and MDAR to create two versions of signs representing pollinator habitat. One sign was designed specifically for MassDOT, to be placed along highways and other high-speed roadways where vegetation has been maintained specifically for native pollinators. The other sign includes text and images to introduce the reader to the variety of pollinators in Massachusetts. These text-inclusive signs will be placed on partner properties where pollinator-friendly vegetation has been planted. In addition to the partner agencies and organizations, MDOC and MassDMH have also requested signs to be placed on their properties where the same or similar pollinator-friendly vegetation has been planted.

Re-Branded Banners

New pull up banners were ordered in FY 18 with the themes "Discover the Wild Side of Massachusetts" and "Experience Life Outdoors." Each district received its own set of banners, as well as a set for FHQ. Banners will be displayed in the offices and used at talks and other public events.

Signs, infographics, ads, and banners were also produced for communicating about areas that have experienced prescribed fires, bats of Massachusetts, caution in rattlesnake habitats, Linking Landscapes for Massachusetts, Cape Cod Trail Race, the Northeast Fisheries Administrators Association, and the Massachusetts Outdoor Heritage Fund.

OUTREACH EFFORTS AND EVENTS

Fairs and Sporting Shows

In FY 18, MassWildlife exhibited at two fairs: the Marshfield and Franklin County (Greenfield) fairs; and four Sporting shows: the New England Fishing and Outdoor Expo (Boxborough), the Springfield Sportsmen's Show (West Springfield), Standish Sportsmens Show (Bridgwater) and the Boston Flower Show. Field Headquarters I&E staff and District staff continued the tradition of selling licenses at the two sportsmen's shows; staff also answered sportsmen's hunting- and fishing-related questions and handed out publications. At the fairs, sporting shows and the Boston Flower Show, MassWildlife exhibits a display of pelts from most of the state's native furbearers so visitors can touch, handle, compare and ask questions about them. General fishing, wildlife, and outdoor recreation questions are also answered, and publications are distributed.

Staff Outreach Participation

Agency staff lead or otherwise participated in public events as workloads and time permit. Some events are generated by the agency, others are events to which the agency is invited to participate. I&E staff consulted with Division staff involved in outreach events, provided display equipment and literature for specific audiences, developed targeted display materials such as posters and handouts, and/or helped to staff the agency's display at these events.

In FY 18, MassWildlife staff participated in at least 39 public talks, walks or staffing a table at a festival or other event. Examples include habitat management site tours, talks on specific topics hosted by other conservation organizations or MassWildlife facilities, staffing tables at community or conservation organization events, State House Day and Earth Week Trout Stocking events.

MassWildlife hosted and participated in at least 14 meetings/conferences at the Field Headquarters: Northeast Trackers Conference, Northeast Habitat Technical Committee Annual Meeting, Northeast R3 Conference, MA Green Careers Conference, Regional New England Cottontail Meeting, Roseate Tern Recovery Team meeting, MA Ecosystem Climate Adaptation Network Conference, Landscape Modeling Workshop, New England Botanical Club Meeting, New England Outdoor Writers Association monthly meeting, USGS MA Coop Unit Annual Meeting, Commonwealth Agency Pollinator Habitat Summit, quarterly meetings of the Massachusetts State Commission for Conservation of Soil, Water & Related Resources and a Legislative Hearing held by the Joint Committee on Environment, Natural Resources and Agriculture.

In addition, agency staff participated and in many cases presented at the 29 following conferences, meetings, trainings, and workshops : MA Conservation Commission and MA Land Trust Conferences, Northeast Fish and Wildlife Conference (VT), Aquatic Plants Workshop (Maine), Coastal Waterbird's Cooperator's meeting, Blue Hills Deer Hunt Public Meeting, New England Public Works Expo, New England Chapter of the International Society of Arboriculture, Conservation Leadership for Tomorrow (CO), Northeast GIS Meeting (RI), MA Trails Conference, Sandplain Grassland Network Regional Meeting, MA Invasive Plant Advisory Group Meeting; Rivers and Roads Training with MassDOT, Tern Database Meeting with MassAudubon, Southern New England Chapter of American Fisheries Society meeting, Westfield Invasive Species Partnership Meeting, Task Force Meeting with New England Wildflower Society; Invasive Mussel Collaborative webinar, Deer Overabundance Planning Meeting with stakeholders from Canton, Sharon, Foxborough, Easton, Mansfield, MA Wildlife Rehabilitator's Conference, MassAudubon Birder's Meeting, Berkshire Natural History Conference, Southern New England Chapter of the Soil and Water Conservation Society, UMass Keystone Project, New England Outdoor Writers Association Annual Meeting, DCR Proposed Hunting Expansion on Wachusett Watershed Lands public meeting, MA Land Trust and State Agency Land Acquisition Retreat, Secretary's Advisory Group on Environmental Education.

MassWildlife staff also offered university guest lectures at UMass-Amherst (3 lectures), Antioch University (NH) and Wheaton College.

NHESP Outreach

Outreach Specialist Elaine Brewer worked on a variety of initiatives to promote the Natural Heritage and Endangered Species Program (NHESP). In the MassWildlife Monthly enewsletter, 23 articles based on NHESP activities and species were published this year. Elaine Brewer took part in the basic Prescribed Fire training, held at Camp Edwards in September 2017, and took part in the refresher course in May 2018. She has been able to participate in one prescribed burn thus far and is eager to participate in more in FY 19. Elaine has also gone into the field to learn about the projects NHESP is currently working on, as well as to build the photo and video library for NHESP projects. In FY 18, she was able to photo or video and assist with: forest bird surveys, Crane WMA, Muddy Brook WMA, mussels surveys, peregrine falcon banding, bald eagle banding, and salamander surveys. In FY 19, Elaine plans to add coastal waterbird, insect, and botany field days to her photography and videography work.

In FY 18, she began to research and outline a communication strategy for NHESP. The strategy is intended not only for Elaine to use as a base for her work, but for all NHESP staff to use as a reference for any outreach or communications they do. As part of the creation of the communications strategy, Elaine has and will continue to host meetings with NHESP staff for their input in the strategy, making it cohesive for the entire section. This strategy is estimated to be completed and in use by

mid-FY 19. The strategy outlines the goals of NHESP and how communications can assist in achieving those goals. The document includes a brief history of marketing and communications within the section, target audiences, and campaign plans for promoting NHESP work throughout the year. This strategy is planned to be a living document, in that it will be added to annually, based on NHESP projects and evolving trends in communications.

PUBLICATIONS

Massachusetts Wildlife Magazine

MassWildlife's most visible publication is *Massachusetts Wildlife*, a 40-page, full-color, quarterly magazine with a currently growing base of approximately 20,000 subscribers and a standard publication printing of 25,000 copies that provides surplus for handouts and promotions at programs, shows, and fairs. Editor and Publications Manager Troy Gipps, Senior Photographer Bill Byrne, and I & E Chief Marion Larson along with other I&E staff, produced four issues of *Massachusetts Wildlife* (Number 3, 2017 – Number 2, 2018) covering a wide variety of fisheries, wildlife, and outdoor-related subjects, including wildlife research, rare and endangered species, general nature interest, and "how-to" articles for the hunter, angler, and nature observer.

Continuing a long tradition of producing articles that will be useful as references on particular subjects for many years to come, this year's offerings included:
Issue Number 3, 2017—featured articles on the plight of native bumblebees written by Dr. Robert J. Gegear, Assistant Professor in the Department of Biology and Biotechnology and Director of the Bee-cology Project at Worcester Polytechnic Institute in Worcester, Mass.; the use of Massachusetts Waterfowl Stamp dollars to purchase priority wetlands habitat in eastern Canada to support waterfowl populations in the Atlantic flyway, written by Sarah Fleming, Manager of Conservation Programs for Ducks Unlimited, and Deanne Drouillard, Manager of Eastern Region Partnerships for Ducks Unlimited Canada; Red Maple bark variability by Scott S. Hobson, who published a book on the topic in 2015; and The Worst Deer Hunter Ever?, Ken Carlson's personal story of how he lost the use of his legs in an automobile accident 40 years ago but did not allow his physical disability and use of a wheelchair to prevent him from enjoying outdoor pursuits such as hunting and fishing.

Issue Number 4, 2017—featured articles on Joseph A. "Archie" Hagar, State Ornithologist for Massachusetts from 1934_1959, written by Wayne Petersen, NHESP Board Member and Mass Audubon's Director of Massachusetts Important Bird Areas Program; Hunting for Likes—an article providing advice to hunters sharing their hunts on social media platforms, written by Nicole McSweeney, MassWildlife's Outreach and Marketing Coordinator, and Astrid Huseby, MassWildlife's R3 Coordinator; and "Labors of Love: Managing a Small Woodlot for Wildlife" written by Bill Davis, MassWildlife's Central Wildlife District supervisor.

Issue Number 1, 2018—this issue contained a three-part feature article on the Common Carp, written by MassWildlife's current Gold Pin winner for Common Carp, Dean Brookes, the History of Common Carp, written by the American Carp Society founders Wayne Boon and Sean Manning; A Prescription for Fire by Alex Entrup which described the work that goes into safely planning and executing a prescribed fire on wildlife habitat; and a 2017 update on the affect of the Gypsy Moth outbreak on the forests in Massachusetts and surrounding states written by Joe Elkinton, Jeff Boettner, and Valarie Pasquarella from the University of Massachusetts Amherst.

Issue Number 2, 2018—this issue included comprehensive articles on the Common Loon conservation in the Northeast being conducted by the Biodiversity Research Institute (BRI) and its partners, written by BRI staff; the result of experiments conducted by Dr. Richard A. Callahan and his colleagues on the effects of Neonicotinoid insecticides on honey bees; Bird Banding by Fisheries and Wildlife Board member Brandi Van Roo; and the story of a 93-year-old World War II veteran's desire to participate in a final fishing trip at a local trout-stocked pond and the great support provided by members of his town after his daughter requested assistance on social media sites in Haverhill, Mass., written by Alison Colby-Campbell; and the obituary for MassWildlife's long-time photographer Bill Byrne.

Magazine Subscription Efforts:

The beginning of the fiscal year July 1, 2017 showed 20,092 subscribers for the magazine. By June 30, 2018 there were 20,099 magazine subscribers.

During FY 2018, four effort renewal mailings were sent

out for renewals totaling 10,195. Total cost of these mailings was $3,639 resulting in revenue of $27,331 from 2,827 renewals. There was no nominee offer to renewals during this fiscal year. 4,251 cash acknowledgements were sent out at a cost of $1,517. Revenue from 920 orders was $6,440. There was no new business direct mail solicitation during this fiscal year. Gift subscription renewal efforts resulted in mailing to 9,302 subscribers who have given gifts, at a cost of $3,201 resulting in revenue of $27,512. Another mailing at a cost of $1,991 went out to 5,578 subscribers who had not given gift subscriptions in the past with a revenue result of $2,256.

In FY17 (on January 5, 2017), magazine subscriptions were available for purchase through the MassFishHunt licensing system. During FY18, 934 subscriptions (166 at the one year, 4-issue rate of $6.00, and 768 at the two-year, 8-issue rate of $10.00) were sold through this purchasing option.

Guide to Hunting, Freshwater Fishing, and Trapping

The *2018 Guide to Hunting, Freshwater Fishing and Trapping* was again produced in cooperation with J. F. Griffin Publishing Co., as part of a multi-year contract with this publisher. The full-color, glossy-stock, 56-page booklet includes a digest presentation of the fishing- and hunting-related laws and regulations and other information of interest to sportsmen. A publications order form was provided for the first time which has been successful. Publications Manager Troy Gipps and I & E Chief Marion Larson contributed much of their respective time to the production of the Guide. 185,000 copies were printed, representing another 5.6% drop in copies from last year due to left overs at the end of the year. This is the third year in a row that guide printing numbers were reduced (FY17 196,000). An electronic website of the Guide has been provided by the publisher as part of the contract and this site has been visited often.

Publications Sales

Though publications information and forms have been posted on the website for a number of years, a mechanism for tracking sales of publications went into place in the spring of 2017. FY 2018 is the first full year for tracking publications sales.

Other publications for sale had orders of 20 copies or less for the year. Publications available for free for pick up are also available to order with the price of shipping. The BioMap 2 Technical Report topped the list with 91 orders and 19 Bird Checklists were requested. All other free publications had requests of 10 or less for the year.

PHOTOGRAPHY

Bill Byrne, Senior Photographer (partial year, deceased May 2018)

Two primary photographic goals were achieved in FY 18, that of providing suitable images for the 2018 Guide summary of fishing, hunting, and trapping regulations, and on a much larger scale, providing processed images for the publication of four issues of *Massachusetts Wildlife* magazine.

For each issue there is a variety of image sources, some by contributing authors, some by MassWildlife staff with special projects, and many by photographer Byrne. All images must be digitally processed to conform to high standards of color contrast, sharpness and dimensions to help insure the best reproduction. Then there are multiple rounds of color proofs and a final press check at the printing vendor to insure the best quality issue goes to our readers.

Throughout FY18, there were many ongoing events that were photographed including the Junior Duck Stamp competition awards, Massachusetts Freshwater Sportfishing Awards Program, and the Conservation Camp graduation/award ceremony.

Number of Copies	Publication Name
365	Vernal Pool Guides
114	Reptile and Amphibian Guides
68	Invasive Plants Guide
58	Field Guide to Dragonflies and Damselflies
54	Massachusetts Wildlife mag (individual issues)
28	Critters of Massachusetts
22	Field Guide to Massachusetts Reptiles

Requests for images by staff for publications, presentations and species accounts were fulfilled not only by the Senior Photographer, other I & E staff (I & E Chief, Outreach Coordinator, Communications Coordinator and I & E Specialist) have also made themselves familiar with the files to utilize photos for the agency social media and newsletter needs, program needs and media inquiries.

In addition, Editor Troy Gipps took images of Junior Duck Stamp artwork, American Kestrel banding, MassWildlife's Employee Day at the Connecticut Valley Wildlife District office, Earth Week Trout Stocking at Lake Quinsigamond, and Necropsy Staff Training in the Westborough Field Headquarters.

Education Programs

Staff members of the I&E Section offer programs to civic, school, community, conservation, and sportsmen's groups on a variety of wildlife-related topics throughout the year, for both youth and adult audiences. Through our wildlife education programs (general wildlife, wildlife in the backyard, wildlife in the schoolyard, endangered species, tracking, living with wildlife, wildlife and habitats), public appearances at conferences, and workshops, we reach out to urban youth, scouts, early childhood educators and administrators, pre-service teachers, undergraduate and graduate college students, formal and non-formal educators, and other adult audiences.

General wildlife education programs were attended by 856 people.

Formal or School-based Education Programs

Pam Landry, Education Coordinator

Educational programs by Education Coordinator Pam Landry focus on groups of educators, students, and youth gatherings, but were also highlighted at other public events.

Project WILD & Aquatic WILD

Project WILD is one of the most widely-used wildlife-focused conservation and environmental education programs among educators of students in kindergarten through high school. It is based on the premise that young people and educators have a vital interest in learning about our natural world. Project WILD addresses the need for human beings to develop as responsible citizens of our planet and fosters responsible actions toward wildlife and related natural resources. Through the use of balanced curriculum materials and professional training workshops, Project WILD accomplishes its goal of developing awareness, knowledge, skills, and commitment. This results in the making of informed decisions, responsible behavior, and constructive action concerning wildlife and the environment. In Massachusetts, Project WILD is sponsored by MassWildlife and the Association of Fish and Wildlife Agencies, with support from the Massachusetts Sportsmen's Council.

Growing Up WILD: Exploring Nature with Young Children

This early-childhood (ages 3-7 years) education program builds on children's sense of wonder about nature and invites them to explore wildlife and the world around them through a wide range of activities and experiences. Growing Up WILD is a tool for helping fish and wildlife agencies meet their conservation goals by recognizing that children start developing attitudes towards wildlife and nature at an early age, providing knowledge and skills to early childhood educators so they may teach about nature, providing suggestions for outdoor nature-based recreation, providing conservation suggestions for each activity, providing activities that families can do together, and laying the foundation for acquiring increased scientific knowledge and problem-solving skills. There was a continued strong focus on connecting Growing Up WILD to Science, Technology, Engineering, & Math (STEM).

13 Project WILD & Growing Up WILD facilitators, contributing 405 volunteer hours, offered 16 workshops (14 GUW, 2 WILD) that reached a total of 270 pre-K-Grade 12 educators

Workshop participants included undergraduate and graduate college students, formal and non-formal educators, nature center natural history guides, state park interpreters, homeschooling parents, librarians, Montessori teachers, Student Conservation Alliance volunteers, scout leaders, and summer nature camp staff. Early-childhood educators attending workshops represented staff from: family child care and child care centers, Massachusetts Association for the Education of Young Children, Head Start and Early Head Start, Department of Early Education and Care, Montessori schools, YMCAs, state and community colleges, Self-Help/Community Partnership for Children, the Amer-

iCorps Student Conservation Alliance, children and science museums, and child care resource and referral agencies.

A multiplier (75) used by the National Project WILD office would suggest that the 270 educators reached would ultimately educate 22,250 youth/year.

23 Project WILD facilitators attended the annual facilitator gathering. A presentation was given by Scott Jackson, Extension Associate Professor in the Department of Environmental Conservation at UMASS Amherst on Climate Change: Adaptation to Conservation, Wildlife and Ecosystems with a focus on the Climate Action Tool.

The North American Conservation Education Strategy (CE Strategy)

An array of tools developed by state fish and wildlife agencies support conservation educators who offer fish and wildlife based programs that guide students in grades K-12 on their way to becoming involved, responsible, conservation minded citizens. The CE Strategy delivers unified research-based Core Concepts and messages about fish and wildlife conservation, translated into K-12 academic standards to shape students' environmental literacy, stewardship, and outdoor skills. Resources included in the toolkit include: landscape investigation, schoolyard biodiversity, field investigation, fostering outdoor observation skills, using technology in field investigations, applying systems thinking, and much more. Material was distributed to educators when applicable or they could download resources at www.fishwildlife.org (focus area, conservation education, tool kit).

Junior Duck Stamp Program (JDS): Connecting Youth with Nature through Science and Art

Students in grades K-12 from across the Commonwealth submitted 386 pieces of artwork to this "Conservation through the Arts" program. Entries were received from public, private, and home schooled students; scouts; individuals; and private art studios. The judging, by a panel of five professional wildlife artists, took place at the Division of Fisheries & Wildlife Field Headquarters, Westborough. The acrylic painting of Canada Geese by Michelle Gong, Apple-Leaf Studio was selected as Best of Show and represented Massachusetts at the National Competition finishing in the top 15. Nearly 200 people (student artists, families, judges, supporters and teachers) attended the awards ceremony held at the Field Headquarters. Combinations of the top 100 pieces of art were part of a statewide traveling exhibit appearing at eleven venues. Curriculum for students, educators, home school, and non-formal groups designed to spark youth interest in habitat conservation through science, art, math and technology was made available to student artists & educators upon request. In Massachusetts, the Junior Duck Stamp Program is sponsored by MassWildlife and U.S. Fish and Wildlife Service, with support from the Massachusetts Sportsmen's Council.

Massachusetts Envirothon

MassWildlife's continued involvement in this natural resource program, which reaches over 500 urban and rural high school students representing over 50 communities annually, continues through the efforts of Wildlife Education Specialist Pam Landry. She hosts teacher and student workshops, serves on the education subcommittee of the steering committee, prepares the wildlife exam, provides wildlife-related information to the Current Issue question (Partnering with Nature in Watersheds), and attends the competition. Several other Division staff played roles in this important program by volunteering in various capacities on the competition day in May. The Chief attended quarterly meetings of the Massachusetts Envirothon Council. Its purpose is to provide support for the event operation in coordination with the Mass. Commission on Soil, Water and Related Resources. In advance of the 2018 Envirothon, MassWildlife hosted a Coach's Workshop in October 2017 at the Field Headquarters, which was attended by 10 coaches from across the state. Despite hot weather, coaches were enthusiastic. The 2018 Envirothon was held in May at DCR's Riverbend Farm, Uxbridge.

Massachusetts Junior Conservation Camp

In August 2017, the Conservation Camp held its 2-week session at Boy Scout Camp Moses in Russell. Facilities at this location are an improvement from the past location. Approximately 100 campers attended. As in the past, MassWildlife staff assisted by providing instructors and coordinating arrangements with other state-based instructors. MassWildlife staff and MassWildlife program volunteers offered Basic Hunter Education and Bow Hunter Education courses to the campers; provided instruction in wildlife management, fisheries

management, game preparation, and cooking skills; conducted the information quiz that evaluates the participant's comprehension of outdoor information and skills presented during the camp session; and participated in the graduation ceremonies. The I & E Chief attended meetings of the Massachusetts Junior Conservation Camp Board serving as member of the Board of Directors. She coordinated the scheduling of classes MassWildlife, DCR and Environmental Police staff and some evening programs for camp. She offered a Fish and Wildlife Careers program on one of those evenings.

Recruitment, Retention and Re-Activation (R3)
Astrid Huseby, Hunting Recruitment and Retention Reactivation (R3) Coordinator

The R3 Coordinator is charged with designing and coordinating an overall plan to promote hunting in Massachusetts by enhancing current programs, as well as through the development and implementation of new programs through a Hunting and Angling R3 Plan for Massachusetts.

Marketing Efforts to Promote Fishing
Marketing efforts, monitoring and analysis was conducted by Nicole McSweeney with assistance from Emily Stolarski and Associate Director Kris McCarthy.
Associate Director Kris McCarthy and Outreach and Marketing Coordinator Nicole McSweeney presented at the Recreational Boating and Fishing Foundation (RBFF)'s Annual State Marketing Conference in December 2017 to share results of MassWildlife's 2017 spring fishing marketing campaign, which used digital strategies like banner and video advertisements, paid Google search advertisements, and paid Facebook advertisements, as well as postcards and emails to promote fishing in Massachusetts.

Upon evaluating the 2017 campaign, MassWildlife identified some problems with tracking the success of digital campaigns. Several I&E staff completed Google Analytics Training in FY 18 to better understand website evaluation tools. To address tracking and evaluation issues, MassWildlife submitted and was awarded a competitive 2018 State R3 Grant from RBFF. Through the spring of 2018, the Outreach and Marketing Coordinator and the Communications Coordinator worked with the MassFishHunt vendor and Mass.Gov staff to enhance our ability to track anglers through the purchase process from various marketing initiatives, including placing tracking pixels on our websites and turning on the E-commerce feature in Google Analytics to capture customer ID information. A handout was also created for distribution at Angler Education events which uses a custom UTM link to collect information about Angler Ed participants and the information they are looking for after taking a course.

To prepare for the spring 2018 marketing campaign, MassWildlife contracted with the Marketing Doctors, a local marketing firm, to evaluate the 2017 campaign, make recommendations for 2018, and place ads for the 2018 campaign. Based on learnings from FY 17, MassWildlife utilized paid Google search, social media (Facebook and Instagram) advertisements, postcards, and emails in FY 18 to recruit new angling participants and retain/reactivate existing customers. The Human Dimensions Coordinator Jody Simoes provided updated customer information to better target digital campaigns in 2018. Ads will run through the end of July 2018. Initial feedback suggests these marketing efforts were extremely successful in increasing fishing license sales.

Other R3 Efforts
R3 Plan Development
Workgroups were formed to further R3 plan development. A number of staff attended national/regional R3 related conferences including the RBFF State Marketing Workshop in December, American Sportfishing Association Summit in October, National R3 Symposium in May. Industry partnership efforts with Cabela's in Berlin included creating and providing shopping bag inserts at during the winter holiday season, a rod donation event at the store, program promotion in Cabela's spring catalogue, Touch a Truck with a stocking truck and staff table by Jim Lagacy.

Youth Skills and Recruitment Programs
National Archery in the Schools Program in Massachusetts
This program offers international-style target archery training with a national standardized education package in cooperation with state fish and wildlife agencies across the country. The National Archery in the Schools Program and the Archery Trade Association have partnered with MassWildlife and the Massachusetts Outdoor Heritage Foundation to promote student education and lifelong interest and participation in the sport of archery in Massachusetts.

The National Archery in the Schools Program (NASP) is a part of the in-school curriculum, generally a physical education class. This means all students have an opportunity to try archery, including many who may not otherwise show an interest in the sport. The NASP curriculum is designed for students in grades 4-12, and includes social studies, mathematics, and physical education. MassWildlife provides a 1-day Basic Archery Instructor training for physical education teachers within schools/districts that plan to participate in NASP. In addition, MassWildlife coordinates the ordering and delivery of program equipment for the schools. In order to receive training, schools must obtain the NASP equipment kit, at a cost of about $3,000 and includes 11 Matthew Genesis bows, 122 arrows, 5 targets, 1 arrow curtain, and 1 tool/repair kit. During FY 18, eight new schools received teacher training in NASP with a total of 113 schools participating in the program. Some schools provided their own funding; others used the new loaner kits that were created this fiscal year.

Young Adult Pheasant Program

The Massachusetts Young Adult Pheasant Hunt Program was developed by MassWildlife to provide an opportunity for 12-17-year-old Hunter Education graduates to practice firearms safety, develop shooting skills, and participate in a special pheasant hunt with an experienced pheasant hunter in a friendly environment. The program is run by participating local sportsmen's clubs. This program is a comprehensive, three-part recreational program. Shooting instruction and practice take place during the summer or early fall; the pre-hunt workshop is held a week or two before the youth pheasant hunt; the actual hunt is scheduled by the individual clubs for any one of the six Saturdays prior to the mid-October start of the regular pheasant hunting season.

Table 2. FY 2018 Youth Pheasant Hunt Participating Clubs

Club	Number of Participating Youth
Carver	10
Essex	3
Falmouth Georgetown	13 5
Lee	6
Norco	19
Walpole	3
Worthington	2
TOTAL	61

Youth Turkey Hunt Program

This program was developed by MASSWILDLIFE in cooperation with the Massachusetts Chapter of the National Wild Turkey Federation (NWTF) to provide an opportunity for 12-17-year-old Hunter Education graduates to practice firearms safety and turkey-hunting techniques, develop shooting skills, and participate in a special 1-day turkey hunt under the one-on-one guidance of an experienced turkey hunter. The Recruitment and Retention Specialist coordinates the Youth Turkey Hunt.

The program is offered by participating local sportsmen's clubs in partnership with local chapters of the NWTF. It is a comprehensive, three-part outdoor education program designed to give young hunters an opportunity to acquire some of the specialized skills associated with the activity. Hunter safety is emphasized to help build the confidence of the inexperienced hunters so that they will feel comfortable when in the field.

The Youth Turkey Hunt Program takes place in the spring. Shooting instruction, practice, and the pre-hunt workshop take place two or three weeks prior to the day of the hunt. The actual turkey hunt takes place on the Saturday prior to the last Monday in April.

In FY 18, a 1-day mentored Youth Turkey Hunt was held on April 28, 2018, the Saturday preceding the opening of the spring season. A total of 69 new students (sponsored by 14 clubs) completed the pre-hunt training and participated in the field exercise and the hunt. 205 previous-year Youth Turkey Hunt Program participants returned to obtain a youth turkey permit in the 2018 event and did not need to repeat the pre-hunt training and field exercise.

The following sportsmen's clubs participated in the program, in cooperation with the NWTF state chapter (Table 3).

Table 3. FY 2017 Youth Turkey Hunt Participating Clubs

Club	Number of Participating Youth
Barre	11
Carver	8

Cheshire	3
Conway	16
Falmouth	4
Fitchburg	3
Lee	8
Norco	5
North Brookfield	2
Stockbridge	5
Worthington	9
Wrentham	12
Total # New Youth Hunters	67
Returning Youth Hunters	205
TOTAL	274

Learn to Hunt Program

The Learn to Hunt Turkeys and Deer Program were designed for new hunter education graduates who want more information/experience before feeling comfortable enough to hunt.

Learn to Hunt Turkey Program: The learn to hunt turkey program was started in 2015 with one 3-day mentored turkey hunt and two single day workshops, we have slightly adjusted the classes each year based on survey feedback. In FY18 we had:

- 1 single day workshop with 15 participants
- 1 two-day program with mentored hunt with 18 participants
- One half-day turkey clinic with 12 participants

Learn to Hunt Deer Program: The learn to hunt deer program was started in 2015 with one 3-day deer program and two single day workshops, we have slightly adjusted the classes each year depending on the survey results. In FY18 we had:

- One two-day program with 23 participants
- Two half-day workshops, scouting with 29 and field dressing and processing with 35 participants.

Becoming an Outdoors Woman Program

Becoming an Outdoorswoman (BOW) is a program designed for women ages 18 and older, providing basic outdoor skills sessions. Once again, BOW partnered with the Massachusetts state chapter of the NWTF with the Women in the Outdoors Event in July 2016 in which ~140 women ages 13 and up attended. MassWildlife staff offered Bird Identification and Fishing as part of the program and sponsored the event meals.

Table 4. BOW workshops held in FY 18.

Date	Title of Program and Location	# of Participants
July 2017	Women in the Outdoors-Wild Turkey Federation MA Chapter Event	140
October, 2017	Deer Hunting Seminar, Devens	19
December, 2017	Deer Hunt, Devens	20
April, 2018	Turkey Hunt Seminar, Devens	12
May, 2018	Turkey Hunt, Devens	10
Total Participation		205

Angler Education Program

The Angler Education Program is an education/outreach program within the Education Section of MassWildlife. It is the main component of the Aquatic Resource Education Program. The other component is Aquatic Project WILD, which the Wildlife Education Specialist oversees. The Angler Education Program has several components designed to introduce people to fishing and the outdoors, including family fishing festivals, fishing clinics, fishing classes, and our own Fishing Tackle Loaner Program.

The Angler Education Program is in part a volunteer-run operation. All instructors complete a volunteer application and are checked through the Criminal Offender Record Information (CORI) system. They are given pertinent information about MassWildlife and the Angler Education Program, and then begin apprenticing at program events. Instructors are recruited by press releases, our many fishing programs, fairs, sportsmen's shows, positive publicity, and word of mouth.

113 volunteer instructors.
Approximately 70% were active during FY 18.

Family Fishing Events
Our weekend family fishing events are set up as an introduction to fishing, where we make available rod-and-reel combinations, terminal tackle, and bait at no charge, and when the manpower allows, instruction in casting, fish identification, knot tying, baiting, cleaning, and filleting.
Conducted 31 family fishing events.
Total estimated participation was 4,268 people.

Family Fishing Clinics
Our fishing clinics, while short in duration, are a very popular program component. These clinics are typically co-sponsored by town recreation departments, sporting clubs, Boy and Girl Scout troops, and or other state or federal agencies that we partner with. These are generally two to three hours long, involving a short lecture on fish, fishing, safety, and ethics, followed by casting instruction and a healthy dose of fishing. Fishing educational handouts are generally provided and clinic participation is kept small enough to allow the instructors to work with participants one-on-one.

62 fishing clinics
Approximately 1,496 participants (mostly children)

Fishing Classes
A few specialty fishing classes are conducted each year, such as fly tying, or pilot adult-only "Learn to Fish" classes.

Conducted 9 fishing classes:
4 fly tying classes,
2 adult "learn to fish" classes,
2 in-school classes Auburn High School Physical Education Fishing Program classes,
1 basic fresh water fishing class, Hardwick Elementary School.
Total number of participants: 239.

Fishing Tackle Loaner Program
The Angler Education Program keeps and maintains fishing equipment onsite for loan to various groups throughout the state. Loaner equipment includes basic spincasting rods, spinning rods, salt water rods, as well as fly rods and fly tying equipment and even ice fishing gear. Equipment was loaned to various groups and agencies, including the Massachusetts Department of Conservation and Recreation (DCR), the U.S. Army Corp of Engineers, the U.S. Fish and Wildlife Service, various sportsmen's clubs, scout troops, church groups, and private citizens. Along with the fishing gear, the necessary terminal tackle and various fishing education program handouts are also provided.
Equipment loaned on 29 separate occasions utilizing 795 pieces of equipment.
Massachusetts Junior Conservation Camp – The Angler Education Program has always lent a hand to this camp, teaching both the fishing and the fisheries sections, as well as contributing fishing equipment, education materials, and extra manpower.
12 sessions taught: 6 sessions of basic fishing and 6 sessions of fisheries management to approximately 119 campers.
Cooperative Programs
Trout Stocking Programs - These programs are performed in the spring (April and May) and for the most part with various school groups around the state. These are more promotional than educational. We occasionally link them to fishing clinics and in-class presentations, but for the most part the groups show up, are given a short lecture about the agency and our fish stocking programs, after which they help MASSWILDLIFE staff stock a given pond, lake, or river.
12 trout stocking programs, totaling roughly 499 people.

Information & Education Staff

Marion E. Larson, Chief, Information & Education
Emily Stolarski, Communications Specialist
Nicole McSweeney, Outreach and Marketing Coordinator
Gary Zima, Senior Planner
Troy Gipps, Editor and Publications Manager
Bill Byrne, Senior Photographer
David Gabriel, Graphic Designer
Pam Landry, Education Coordinator
Astrid Huseby, Hunting R3 Coordinator
Jim Lagacy, Angler Education Program Coordinator

Archivist

James E. Cardoza, CWB®
Wildlife Biologist
Contract Librarian and Archivist

This is a 12-month progress report on my FY18 contact relative to the collection, cataloguing, storage, and shelving of MassWildlife's archives, historical artifacts, and library materials, and related matters.

I completed all the backlog of the stored library books, journals, theses, and gray literature during FY17. Those items can all be located and signed out using an on-line system developed by Robert Morley. I continue to receive some books, theses, and other materials from donors or otherwise and enter those into the library system periodically.

Robert Morley also developed an archival data entry, location, and sign-out process for archival materials, similar in concept to that for the library. Items are catalogued within that database as "museum" (artifacts) and "archives" (paper items). This system is not yet on-line and available for use but can readily be done pending action by Morley. Some physical objects will not be available for individual sign out, but must be cleared with the Chief of Information & Education due to fragility or substantial rarity or value.

I have entered all the museum artifacts except for a few boxes which have yet to be retrieved from the State Archives at Columbia Point. I have entered all the other materials which I had personally boxed up for storage prior to the move from the former Overlook Building. I have also begun sorting and cataloguing of other materials which were boxed by others and have been or will be transferred to me.

I have set aside 13 boxes of antique glass slides or large film negatives and have sorted those from 12 of the 13 numerically and arranged them in numerical sequence in the purpose-built wooden boxes (n=12). One cardboard box contains slides wrapped in bubble wrap; a sturdier container should be constructed.

I have created a spreadsheet and have entered each slide or negative into that spreadsheet in numerical sequence (as to the pre-existing number on the item) along with the bar code number of the box it is contained in, key words, and a brief description. I have completed this entry for 7 of the 12 wooden boxes. Persons interested in slides or negative on a particular subject may then search the spreadsheet. Many of these are the originals of positives found in the historical scrapbooks. Some of the antique large-size film negatives are in fragile film envelopes and a supply of these envelopes is needed to replace the fragile ones. I have begun to look at the metal film containers for past motion picture footage with a view to cataloguing those at a future date.

I continue to assist various staff who have historical questions, seek copies of book, papers, or other publications not held by MassWildlife, or who are unable to locate or access existing library or archival material.

Outside the contract hours, I continue to work with Thomas French and Gwilym Jones on the proposed book on "The Mammals of Massachusetts", for which we began collecting data and references ~30 years ago and which is now in the draft preparation stage.

Photo by Troy Gipps/MassWildlife

Hunter Education

Susan Langlois
Administrator

Overview

It is the mission of the Massachusetts Hunter Education Program to protect the lives and safety of the public, promote the wise management and ethical use of our wildlife resource, and encourage a greater appreciation of the environment through education.

The Hunter Education Program is a public education effort providing instruction in the safe handling of firearms and other outdoor activities related to hunting and firearm use. The Massachusetts Hunter Education Program evolved from a survey conducted in 1954 indicating that 75% of Massachusetts hunting accidents officially involved minors. In that same year, the State Legislature enacted a law establishing a Hunter Education Program providing instruction in basic hunter education. The program is administered by the MDFW, and courses are taught by agency staff and certified volunteer instructors. Courses are open to everyone and no one shall be denied access to the course because of age, sex, race, color, religion, or country origin. All courses are offered free of charge to the participants.

Courses

Courses were offered in six disciplines across the state in FY18. A total of 4,327students participated in the Hunter Education Program. Although lower than FY17 totals, participation levels are comparable with the five-year average of 4656 students. Students are asked to volunteer information on age, gender, and ethnic background on their registration forms. The following is a summary of course offerings and statistics on student participation in FY18.

Basic Hunter Education

Starting January 1, 2007, anyone, 18 years of age or older, who wishes to hunt for any bird or mammal in the commonwealth, must successfully complete a basic hunter education course unless such person has held a license to hunt, before January 1, 2007. The basic hunter education course is a standardized curriculum which provides information on the safe handling and storage of hunting arms and ammunition, hunting laws and ethics, wildlife identification, wildlife management, care and handling of game, basic survival skills, and first aid. Certificate of Completion recognized in all U.S. states, Canada, and Mexico. Ninety-two courses were offered. A total of 3,434 students participated, 3,128 successfully completed the course. Students are asked to volunteer information on age, gender and ethnic background. Of those responding, 867 students were minors (under 18 years of age), 308 were minorities and 645 of the respondents were female.

Trapper Education

Trapper Education is mandatory in Massachusetts for Problem Animal Control (PAC) agents and first-time trappers in order to apply for a trap registration number. This course includes both classroom work and field training. Students learn the proper use of traps and how to set them, the identification of furbearing animals and their habitats, trapping laws and ethics, and landowner relations.

Four courses were offered, with a total of 175 participants. One hundred and forty-two participants successfully completed the course. 23 minors (under 18 years of age), 16 minorities and 22 women participated.

Bow Hunter Education

The Bowhunter education curriculum standards were revised in May 2017 by the IHEA in cooperation with the National Bowhunter Education Foundation. This course is designed for both the experienced and novice hunter. Course topics include the selection of equipment, safety, ethics, bow-hunting methods, and care and handling of game. Bowhunter Education is not required in Massachusetts and a Bowhunter Education certificate does not qualify a person to purchase a Massachusetts Hunting or Sporting license. A Massachusetts Bowhunter Education Certificate is accepted, however, in other jurisdictions that do mandate the successful completion of the course. Twenty courses were conducted. A total of 513 students participated and 508 successfully completed the course. One hundred minors (under 18 years of age), 34 minorities and

73 women participated.
Waterfowl Identification and hunting

This course teaches the identification of migratory waterfowl. It emphasizes the importance of distinguishing waterfowl in flight and includes identifying fall and winter plumage patterns and the size, shape, and flight characteristics of the birds. This course also covers hunting safely from boats and blinds and waterfowl hunting techniques. Two courses were conducted. Twenty-eight students attended. Two minors (under 18 years of age) and 7 women participated.

Black Powder (Muzzleloader) Education
This course was suspended in 2016 for review and revision. The course was revised and tested in FY2018. The course includes the identification and selection of hunting equipment, state laws and regulations regarding muzzleloader hunting and the safe handling of muzzleloaders. A live-fire segment has also been added. Two pilot courses were conducted. Thirty-four students attended; one did not complete the course. Adjustments will be made and additional pilot courses will be conducted in FY19

Map, Compass & Survival
This 1-day course includes both classroom work and field training. Topics include instruction on the use of a compass and topographical map for land navigation as well as wilderness survival. Eight courses were conducted (two in Pittsfield and six in Westminster). A total of 143 students participated.
Shooting Range Development and Enhancement
It is MassWildlife's objective to provide access for the public to range facilities for hunter education and shooting sports purposes by assisting shooting club range development and improvement activities. The Division seeks to amend participation in this funding opportunity by collaborating with third-party entities to increase shooting opportunities and offer advanced (skill-based) hunter education courses for the public across Massachusetts.

Hunter Education Program Staff

Susan Langlois, Program Administrator
Kim Basso, Administrative Assistant
Timothy Bradbury, Hunter Education Specialist
Steve Foster, Program Logistics
Todd Olanyk, Volunteer Coordinator
Cynthia Pratt, Office Support Specialist
Jesse St. Andre, Hunter Education Specialist
Matthew Stover, Hunter Education Specialist


Photo by Troy Gipps/MassWildlife

District Reports

Patricia Huckery, Northeast Wildlife District Supervisor
Jason Zimmer, Southeast Wildlife District Supervisor
Todd Olanyk, Central Wildlife District Supervisor
Ralph Taylor, Connecticut Valley Wildlife District Supervisor
Andrew Madden, Western Wildlife District Supervisor

Overview

Most people who meet the DFW do so through one of the agency's five Wildlife Districts. The District offices are this agency's field stations: administering wildlife lands, conducting on-site management, enhancing recreational opportunities, and addressing the wildlife issues pertinent to their regions.

District personnel sell hunting, fishing, and trapping licenses and stamps and selected permits; and they distribute licenses; Hunting, Freshwater Fishing, and Trapping Guides, stamps; and other materials related to the sale of hunting, fishing, and trapping licenses to vendors throughout their District. They assist officers from the Office of Law Enforcement (OLE) to ensure public adherence to wildlife laws and regulations. District staff assist the Wildlife Lands Section in prioritizing lands to be acquired by locating titles, landowners, and boundaries, and making other arrangements necessary for the acquisition of lands for wildlife. They have also been dealing with mitigation of encroachment issues by adjacent landowners on our WMA lands. Staff have also been assisting the Habitat program with participating in prescribed burns as part of the Biodiversity Initiative on several WMAs throughout the state.

District staff also participated in a wide variety of survey and monitoring programs initiated by the DFW's biological staff based at the Westborough Field Headquarters (FHQ; see the individual Section reports for the status of these projects). Among the survey projects conducted by District staff were the Black Bear habitat study, rare turtle surveys, White-tailed Deer browse surveys and pellet counts, Bald Eagle Breeding Survey, banding of ducks and Canada Geese, New England Cottontail surveys, and stream surveys. District personnel also conduct census counts of Wild Turkey, Woodcock, Ruffed Grouse, and quail.

District staff members enhance recreational opportunities throughout the state by stocking Brown Trout, Eastern Brook Trout, Rainbow Trout, Tiger Trout, and Broodstock Salmon into waters scheduled to receive them. Prior to releasing trout, they monitor the water quality of the designated lakes and streams. They release pheasants on Wildlife Management Areas (WMAs) and in open covers (suitable habitat on public land). They monitor and maintain the WMAs in their region by cutting brush, mowing, trimming trails, assisting with forest cutting operations, planting shrubs, and maintaining roads and parking areas. They emplace gates, erect signs, and make other arrangements related to the protection and management of the agency's lands, buildings, and vehicles. They also build and maintain nesting boxes for Wood Ducks, Eastern Bluebirds, and bats, and establish cooperative agreements with farmers who raise crops on DFW land. District staff members also operate checkstations, where sportsmen register deer, bear, turkeys, and furbearers taken during the designated hunting and trapping seasons.

District Supervisors are the agency's point persons, spending many hours with civic and conservation groups, including sportsmen's clubs and county leagues, and responding to inquiries from interested citizens. They provide technical advice on wildlife matters, particularly on matters pertaining to the handling of nuisance animals. In this context, District staff do a lot of education and deal with a large number of bear complaints, deer damage complaints, questions about coyotes, and other issues dealing with the impact of wildlife on human activities, and vice versa.

In addition to the activities that are common to all of the Districts, there are projects that involve only some of the Districts; these are detailed, when and where applicable, below.

Northeast District

Administration

The Northeast District staff was joined by Jesse Caney, who filled the 4th Wildlife Technician position. He nicely compliments the team, bringing skills needed in the Northeast District including prescribed fire, climbing and mechanical abilities. Interviews were completed for the Northeast District Wildlife Biologist position. The position was accepted by Chalis Bird, a very competent Wildlife Biologist who previously worked at MassWildlife as a Seasonal Technician.

Two-day chain saw trainings were attended by staff. MassWildlife Herbicide SOP documents were reviewed. A bear attack joint MassWildlife-Environmental Police training was attended, as well as a black bear meeting held for police chiefs. Staff participated in LART training meetings. Comments were provided on MassWildlife's proposed dog regulation and extended archery season.

Comprehensive Conservation Planning meetings and conference calls were resumed for the Parker River National Wildlife Refuge with MassWildlife revisiting the Hunt Plan to ensure adequate access for hunters and anglers. Hunt plans for Oxbow, Assabet and Great Meadows National Wildlife Refuges were analyzed, as well.

A Climate Screening Tool and Groton Conservation Trust meetings were attended. The Northeast District Stewardship Biologist participated in a WCE forestry training with MassWildlife habitat staff. The Mass Lands Conference at Worcester Technical High School was attended by the Stewardship Biologist.

An LIS (Land Information System) training was attended by our Stewardship Biologist and District Supervisor. A meeting was held with Lands Acquisition and NHESP staff to create a list of properties with high value for state-listed turtles. Lands Committee meetings were attended. Meetings were held regarding In-Lieu Fee fund use in land acquisition and habitat restoration.

The District Supervisor attended meetings concerning Mt. Watatic Reservation management, Essex County and Norfolk County League business, and DFW Senior Staff and District Manager monthly meetings. Mt. Watatic Advisory Committee meetings focused on correcting signage problems near the top of the mountain where many hikers go awry, and revising the Resource Management Plan. A hike up Mt. Watatic was conducted for fire and safety officials to help determine good access routes.

Research and Conservation

Wildlife

After a few weeks of scouting for Canada geese in June staff started banding with H and the Westborough staff. We will be sending crews of 5-7 people into the suburbs and cities of the Northeast District to drive molting geese to traps set on nearby shores. The wood duck project was side-lined again by lack of ice conditions. The 7th year of the black duck project was productive at the start but then weather conditions changed and the ducks dispersed.

Significant advances were made in permitting for the NAWCA (North America Wetlands Conservation Act) salt marsh restoration project at Kent's Island Creek for American Black Ducks and other wildlife. We are waiting for Combined c.91/Water Quality Certification permits. A site visit was conducted with U.S. Fish & Wildlife associated with MassWildlife's filing of a National Coastal Wetlands Grant to augment funding for the Kent's Island Creek restoration project.

A black bear was hit by a vehicle in the Newton area, immobilized by a LART member, and transported to Tufts Wildlife Clinic, where it was euthanized due to its injuries. A deer was immobilized at Tufts University in Medford, to be euthanized later due to its injuries.

A ruffed grouse survey was conducted in the Westford area. Whip-poor-will surveys were conducted by Wildlife Technician Gahagan over a 5-day period, coordinated through Westborough Headquarters. Staff also assisted with colonial bird surveys and eider banding on coastal islands. Wildlife Technician Caney assisted with prescribed fire at Crane WMA.

A large pine barrens habitat project was initiated at Squannacook River WMA, where field data was collected and a habitat management plan drafted.

Twelve deer check stations operated within the District. Four hunters took part in the paraplegic hunt held at Fort Devens, where one 10-point deer was taken.

Fisheries

The March blizzards wreaked havoc with the stocking schedule, setting the District back about a week or so.

Then there was a sizable stocking truck repair that cut into the District budget.

Northeast District staff attended a stream survey meeting in Westborough. At this meeting, summer stream/river/pond survey assignments were distributed to each District, and discussed. A refresher on fish ID was also conducted. The boat and sampling equipment were in good working order. Stream surveys were conducted on the Nashua River and Concord River using the shock boat, and 37 other streams and rivers using the backpack. Native Eastern brook trout were found despite the drought last summer.

Land Stewardship

Significant progress was made on the federal takings project. This project entailed systematically identifying all contested parcels at Martin Burns WMA that were part of the 1950s land acquisition by MassWildlife from the U.S. Fish & Wildlife Service.

A riparian shrub restoration area on the Squannacook River WMA was damaged by a local farmer's mowing mistake, this despite it being clearly marked. Masswildlife requested reimbursement for the damaged plants to Merrimack River Planning Association, who spear-headed the riparian restoration effort. A $3,000 forestry trespass was discovered at Flint Pond WMA. Staff coordinated site visits with the landowner, Tyngsborough Conservation Commission and MA Department of Conservation & Recreation foresters. A restoration plan was required that addressed the proliferation of invasive species and the planting of native shrubs on the pondshore to replace damaged wildlife habitat.

An MOU was drafted with the South Fitchburg Ron & Gun Club for the Wright's Pond WCE. Public parking spaces were marked with permanent posts and signs. The District Wildlife Technicians made a kiosk for the club. A Forest Cutting Plan for the Surrenden Farm WCE was reviewed.

The District and Realty Section continued to work with the AMC on the Bay Circuit Trail (BCT) License Agreement for the section at John C. Philips Wildlife Sanctuary. MassWildlife led a site visit to look at the trail and held meetings to discuss requirements for the Trail License Agreement application. Staff found a low-impact trail site for the BCT relocation from its current path through a vernal pool and the center of the sanctuary. The Stewardship Biologist reviewed trail maps from Montachusett Regional Planning Association and provided feedback about roads on WMAs that could be included.

There was the continuation of two large projects proposed adjacent to Martin Burns WMA; a housing development called Byfield Estates, and a golf center. To protect MassWildlife interests, staff attended project review hearings held by the Newbury Selectmen, Planning Board and Zoning Board of Appeals, providing comments, as necessary. MassWildlife staff certified a vernal pool jointly owned with the Byfield Estates proponent.

A surveyor was contracted to find and mark a boundary line between MassWildlife and the Comley family for an encroachment case before the Attorney General. A survey RFR was prepared for the Realty Section for land at the Squannacook River WMA in Townsend. Fencing was reinstalled to prevent humans and wildlife from entering a collapsed silver mine at Martin Burns WMA. Planning is underway to permanently close the mine. Staff pulled swallowwort seed pods at an early infestation at Dunstable Brook WMA. Trespass signs were removed at the Squannacook River WCE and the correct MassWildlife access signage was installed.

District and Realty staff coordinated on site visits and comments to the Attorney General about the settlement of the Boudreau complaint. Information was also provided on the Willets and Comley Complaints. Staff met with farmers about renewing License Agreements at William Forward Wildlife Management There has been some outward creep of the corn fields and ruts to fill that was found and corrected.

Jones and Huckery met with an abutter to the Nissitissit River WMA to resolve a possible boundary dispute. The abutter was shown the plan of land, iron pins and deed upon which the MassWildlife contractor based his placement of flagging and signs. The abutter agreed to the boundary and to move equipment and other miscellaneous materials off state land. We received a "thank you" phone call the next morning, and an apology.

The Stewardship Biologist met with JC Engineering to review the survey contract for work at the Squanna-

cook River WMA. The survey turned-up a significant trespass: in-ground swimming pool, pool house and over a ½ acre of land disturbance. She also met with an abutter to the Upper Flint Pond Dam project to review the extent of a proposed easement on his land, then went on to meet with a contractor hired to complete the Biodiversity Report for the Rossbach Wildlife Conservation Easement on the Squannacook River in Townsend.

A dozen 4 x 4 pressure-treated posts were installed along our boundary line with an abutter who continues to use a part of Crane Pond WMA as his personal parking area and driveway. We were grateful for the gas-powered post-hole digger that the Office of Fishing & Boating Access loaned us.

A MEPA site visit for the proposed Squannicook River Rail Trail was attended by staff. Concerns about overuse of a parking lot and loss of access for hunters were primary concerns. Comments were submitted on the MEPA Environmental Notification Form for Rt. 40 upgrades at Long Sought for Pond Access Area. It was concluded that the proposed upgrades would provide safer access.

Wildlife Technicians installed posts and cable gates at Salisbury Marsh WMA; Ferry Road, and Sweet Apple Tree Lane. Staff joined the Pepperell Conservation Agent to clean up a dump site. In coordination with NHESP, spotted knapweed was removed at a site at the Groton Town Forest WCE along the Nashua River. Staff conducted research about mine closure options, for use in closing silver mines at Martin Burns WMA. Contract boundary work at Elbow Meadow WMA was completed and verified.

MassWildlife and Great Marsh Coalition members joined Geoff Wilson, Coastal Ecologist, for a tour of a salt marsh restoration project off Town Farm Road in Ipswich. Mr. Wilson has been researching historical farming techniques in salt marshes and their impact on the health of today's marsh. Attendees were taught how to recognize historical farm ditches, berms, roads, and dams, on the landscape. Incorporating this information into salt marsh restoration projects can improve the extent and speed of restoration.

Natural Heritage and Endangered Species

Nesting habitats for state-listed turtles were created at Squannacook River WMA and Townsend Hill WMA, with follow-up maintenance at the nesting mounds at Upper Parker River WMA. Guidance was provided to a MassWildlife contractor surveying turtles at Martin Burns WMA. An intern entered Northeast District records into VPRS for all rare turtles. Staff attended the NHESP-sponsored regional Blanding's Turtle meeting. Bald Eagle nest surveys were conducted in April at known and potential nest sites in Tyngsborough, Amesbury, Methuen, Haverhill, Newbury, Waltham, Framingham, Milton, Pepperell, Merrimac, Acton, and Quincy. One of the Newbury nest trees fell during a winter storm. We received a tip that they moved to a different part of the Parker River. The Northeast District now has 11 confirmed Bald Eagle nests (up from 9 in 2017). Two chicks were banded from the Amesbury nest, and one from Waltham nest, with assistance from the Southeast District climbing crew. Over 50 interested volunteers and passers-by attended the Waltham banding. A rehabilitated Bald Eagle from the Merrimack River was released in Tyngsborough.

NHESP staff went to the site of the Turner Dam removal on the Nissitissit River in Pepperell to check for brooding Brook Floaters with assistance from District Wildlife Technicians. Northeast District Wildlife Technicians assisted with peregrine falcon chick banding in Lawrence and Lowell.

Enhancement of Outdoor Recreation

The ramp to popular Whites Pond in Concord was repaired improving access for the stocking truck. Wildlife Technicians worked with the Concord Conservation Commission to obtain a key to the post blocking the ramp.

Trout stocking in the Northeast District started on March 12 and ended 12 weeks later on May 23. Our Fisheries biologist was joined by 3 Wildlife Technicians on the daily visits to the Sunderland, Montague, McLaughlin and Sandwich hatcheries. Combined spring and fall trout numbered 105,210; with 91,710 stocked in the spring and 13,500 in the fall. During the fall 2017 stocking there were12,500 rainbow trout and 1,000 brown trout put out. Come spring 2018 the Northeast District stocked the following fish: 46,696 rainbow trout, 18,629 brook trout, 26, and 195 brown trout in 28 ponds (14 stocked once), 7 major rivers, and 67 minor rivers and streams. There were 165 tiger trout stocked this year. Tiger trout stocking sites rotate an-

nually throughout the Northeast District, with anglers at Massapoag Pond (83 fish) in Sharon and Baddacook Pond (82 fish) in Groton being the lucky recipients this year.

Five-thousand pheasants were released into five WMAs and 11 open covers. There was no loss in the number of pheasant covers. No one applied for a Special Pheasant Stocking Permit at Martin Burns WMA. The Danvers Fish and Game Club ran a successful Youth Pheasant Hunt at Martin Burns WMA, and Walpole Rod and Gun Club held their hunt at Charles River WMA. Controlled pheasant hunts were supervised by staff every Saturday at Martin Burns WMA, during pheasant season. MA Environmental Police officers, and friends of MassWildlife, assisted with stocking Kent's Island since the bridge is in poor condition and not yet accessible to stocking trucks.

This year the Earth Day Stocking event was held at Whitehall Reservoir in Hopkinton. Fish hand-outs were distributed to an enthusiastic crowd of anglers, young and old.

Staff met with two retriever clubs that annually run practices at Delaney WMA. Club members were interested in cutting shrubbery and tree branches to improve training. After reviewing the area, it was decided that some vegetation removal would be acceptable. A License Agreement will be drawn-up to permit this activity. Four clubs were issued field trial permits for Delaney WMA.

Ten waterfowl hunters applied for the controlled hunt at Delaney WMA. No primitive camping permits were issued for any WMA. Lastly, 525 target permits were issued for the Martin Burns WMA range.

Outreach and Education

The District Supervisor annually attends the Carlisle Conservation Breakfast in February to discuss what's new at MassWildlife. This year they were interested in black bear conservation, bobcats and deer management. The 2nd annual Vernal Pool Discovery Walk was held by MassWildlife on The Throne in Groton with over 25 adults and children attending. A huge discovery was made: Marbled Salamander larvae. Marbled Salamanders are state-listed as Threatened in Massachusetts and according to MassWildlife's Jake Kubel "The finding in Groton is significant because the species is extremely rare in that region of that state, and it fills an important information gap regarding what we know about the species' distribution in Massachusetts."

Conservation breakfasts were attended with colleagues from Groton, Pepperell, and Townsend. Current and emerging issues regarding state-listed turtles were discussed, as well as other pertinent conservation matters. The 3rd Annual Groton Conservation Summit was attended by District staff to highlight important conservation projects.

MassWildlife attended the Massachusetts Trails Conference where we had a booth and a workshop dedicated to educating people about our Tails Policy and how trails can impact wildlife. Walks and talks included a conservation talk at Franklin Pierce College in New Hampshire, and then Girl Scouts interviewed the District Supervisor about "Living with Wildlife" as part of completing their Bronze Award. Wildlife Technician Gahagan ran a native snake exhibit at Riverfest held by the Nashua River Watershed Association.

A second kiosk was installed at the former Turner Dam access area at the Nissitissit River WMA for posting Pepperell Historical Society information about the site.

Technical Assistance

The Northeast District responded to many wildlife-related calls throughout the year. Multiple calls relating to coyotes included: trouble with coyotes and dogs on conservation land prompted the Concord Natural Resource Director to call MassWildlife for back-up. Several reports of coyotes harming dogs were received by Concord officials. The dogs were reported to be running off-leash which placed them in direct conflict with a possible denning mother coyote. Around 40 people attended MassWildlife's "Living with Coyote" follow-up talk in Concord at the Willard School Auditorium. Focus was directed towards teaching people how to resolve and prevent conflicts between humans and coyotes, and how to distinguish problem coyote behavior from normal behavior. The demonstration of harassment techniques was favorably received.

In a different part of the Northeast District, another coyote alarm was sounded in Woburn about a possible human bite by a coyote. Close coordination by Masswildlife, the Environmental Police and a Woburn detec-

tive uncovered evidence that the injuries were caused by a domestic dog. The dog belonged to a friend of the person the victim was visiting.

A Lunenburg farmer called upset about a bobcat showing up on a neighbor's wildlife camera. There were no reports of the bobcat attacking livestock. MassWildlife staff explained section 37 rights to the farmer.

Staff responded to a call about the Waltham bald eagle chick on the ground. The staff found the fledgling already dead. It was transported to Tufts Wildlife Clinic where it was determined that liver flukes were the cause of death. Many volunteers who follow this nest were deeply distressed and a plan was devised to call MassWildlife earlier next year.

Owl chicks falling out of nests drew a lot of attention, as did the abundance of rabbits.

Southeast District

Administration

There were no personnel changes in the Southeast District in FY18.

The District Supervisor was intimately involved in the ongoing review and public hearing process associated with the proposed new regulation pertaining to the use and control of dogs and other domesticated animals on wildlife management areas (WMA). Several presentations were made to senior staff and the Fisheries and Wildlife Board, a public hearing was held which resulted in extensive comments on both sides of the issue which were summarized for the Board and a final vote was made by the Board to approve the proposed regulation with some very minor amendments based on public comments. The new regulation is expected to go into effect sometime in FY19.

The District Supervisor attended the SafeCapture Chemical Immobilization of Animals course at the Franklin Park Zoo in Boston as part of ongoing required training associated with being on the agency's Large Animal Response Team (LART). He was also involved in multiple R3 working group meetings and planning sessions in Westborough.

District staff also attended the annual employee conference hosted at the Connecticut Valley District Office in Belchertown.

Several District personnel were involved in an emergency response to the Sandwich Fish Hatchery during a severe storm event in March. The storm caused widespread downed trees and power outages and the Hatchery backup generator failed resulting in a lack of water flow to many of the raceways. The District Supervisor received a call from the hatchery at 3am for assistance. He contacted several staff to see if anyone was willing to travel to the District to get stocking trucks and head to hatchery to prepare to emergency stock trout before they died due to lack of oxygen. Jeff Breton, Tech III, immediately responded and they both headed to the hatchery still during the peak of the storm. Later that morning, several other staff also responded and were invaluable to drastically reducing fish losses and alleviating the work on the already tired and stressed hatchery staff.

The District Supervisor spent a considerable amount of time serving as the agency lead on a major issue at our Hyannis Ponds WMA. The Town of Barnstable is facing a significant water quality and supply issue, in part due to ongoing contamination from the Barnstable County Fire/Rescue Training Academy, and has approached the agency to see if they could investigate the potential for establishing a new public water supply system on the WMA. The District Supervisor convened a large stakeholder group consisting of agency personnel, Town officials, MADEP, the United States Geological Survey, Woods Hole and personnel from the Office of Energy and Environmental Affairs to begin to evaluate the issue. A study team was formed and the USGS and Town have been working closely with MassWildlife to begin to study and model water resources on the site with a clear understanding that for anything to happen, no environmental damage has to be demonstrated and a net benefit to wildlife and wildlife habitat on the WMA must be realized in accordance with our policies and regulations. This process will be continuing well into FY19.

All staff involved in the agency's prescribed fire program attended annual fireline safety refresher trainings, as well as completing required work capacity tests in accordance with our Prescribed Fire Handbook and Policy. Dan Fortier, Wildlife Technician II also participated in the Camp Edwards Fire Training Academy in September as one of the course instructors.

Meetings were held with a cranberry grower that holds a long term lease on remaining active cranberry bogs at our Burrage Pond WMA to review the terms of the lease and evaluate options for in-kind projects that could be completed by the grower. We successfully identified a major project that the grower could complete for us on the WMA, which was the reconstruction and restoration and maintenance of the former Elm Street access roadway and parking area at the south end of the property. This lost access greatly impacted sportsmen and other users of the WMA and has seen great support from them, as well as Halifax Town officials. The project began in late May 2017 and is expected to be completed in early FY19.

The District Stewardship Biologist attended the Mass-Land Conservation Conference and the Massachusetts Trails Conference in FY18.

The District Supervisor and the District Biologists provided input to the DFW Lands Committee on potential land acquisition projects, focusing on wildlife habitat and recreational opportunities. The District Stewardship Biologist and Wildlife Technicians monitored Conservation Easements throughout the District.

License agreements, Special Use Permits and/or MOUs were reviewed, monitored, issued or renewed by the Southeast District for agricultural and other special uses on WMAs. The District currently manages 23 agreements. These agreements benefit wildlife by maintaining open habitats, often in places that would otherwise not be actively managed due to staff, equipment, and time constraints, or by arranging for cooperative management that benefits wildlife habitat or wildlife-dependent outdoor recreation.

District staff also met with personnel from the recent In-Lieu of Fee Program to learn more about what the program can offer in terms of funding for land acquisition and wetland restoration and/or enhancement projects on WMAs.

District staff met several times with internal and external personnel and researchers looking at the effects of climate change on our WMAs and some of our typical management practices to evaluate ways to ensure climate resiliency. The information from these meetings were utilized in the creation of a statewide climate planning tool for the agency.

The District Supervisor and Land Agent attended a meeting with the Cape Cod Cranberry Growers to discuss various pathways for any cranberry farmers that are looking to get out of the business and would like to see their land go into Conservation. We discussed various methods, including fee acquisition, WCE acquisition and/or NRCS easement followed by underlying fee acquisition. We also discussed the option of continued cranberry agriculture under either a lease or WCE agreement.

Research and Conservation

Wildlife

Southeast District staff completed multiple annual spring surveys including 3 ruffed grouse drumming surveys (New Bedford/Rochester, Joint Base Cape Cod, Myles Standish State Forest), 1 nightjar survey (Mashpee/Falmouth), 8 breeding waterfowl plot surveys (Eastham, Barnstable, Chatham, Truro, Falmouth, Joint Base Cape Cod) and 3 woodcock peenting surveys (Swansea, Sandwich, Martha's Vineyard). District staff also conducted annual winter American black duck trapping and banding, successfully banding a total of 451 ducks throughout Plymouth, Bristol, and Barnstable counties.

Nesting boxes for wood ducks and Eastern bluebirds were monitored, maintained and replaced on DFW lands and other public and private lands. A total of 98 wood duck nest boxes were checked/maintained at 28 different sites across the District. Further, 4 new boxes were erected, 2 at Frances A Crane WMA in Falmouth and 2 at Washburn Pond WMA in Mashpee.

In June 2018 SEWD worked with DFW waterfowl project leader and biologists from MassWildlife Field Headquarters to capture and band 200 resident Canada Geese. 52 were banded from 5 sites in Barnstable County, 74 from 7 sites in Plymouth County and 74 from 8 sites in Bristol County. District staff also conducted pre-season summer mallard banding at a number of sites using baited traps and/or baited tub launcher sets. A total of 72 mallards were banded including 10 from two sites in Barnstable County, 11 from two sites in Plymouth County and 51 from three sites in Bristol County. Staff also assisted with the 5-year park mallard survey to assist in assessing artificial feeding sites of wintering waterfowl. Staff surveyed a total of 18

locations throughout the District and counted a total of 1,291 ducks, geese and swans.

District staff visited several of our WMAs where invasive mute swans are known to breed and displace or otherwise harm local, native waterfowl and surveyed for active swan nests. Any active nests were documented and then staff returned and oiled eggs to prevent reproduction at the sites.

Staff completed 14 deer browse surveys in 10 towns throughout the District in July and August in order to obtain additional data on the impacts to our forests by deer. Surveys were completed in Carver, Rochester, Barnstable, Bourne, Brewster, Eastham, Falmouth, Mashpee and Wellfleet. This information will be used by the deer project leader to further evaluate regional deer densities and assist in making management decisions, as well as recommendations to Cities and Towns regarding deer management and hunting access.

Former cranberry bogs on our Burrage Pond WMA, now managed as emergent wetlands, were regularly visited and strategically flooded at different depths throughout the year to continue to sustain and enhance wetland habitats and provide suitable conditions for migratory waterfowl. Regular and ongoing maintenance and repairs are needed to many water control structures on the property in order to retain our ability to properly manage habitat at the WMA.

The District assisted heavily with the 10-year coast wide colonial waterbird nesting survey in May 2018, which was last completed in 2006-08. Staff visited many islands from Boston Harbor south to the very tip of the Elizabeth Island chain as part of this survey and documented thousands of nests of species including double-breasted cormorants, herring gulls, greater black-backed gulls, great egrets, black-crowned night herons and several others. This work was very weather dependent and relied on staff to be extremely flexible in their working days and hours.

Southeast District staff assisted with common eider banding in southeastern Massachusetts in May 2018, along with H. Heusmann and other Westborough staff. Eiders were surveyed for and banded on offshore islands including Penikese, Naushon, Nashawena, Pasque, Cuttyhunk, the Weepeckets, Nonamesset, Devil's Foot and Ram Island, as well as several of the Boston Harbor Islands.

As part of a multi-state collaborative effort to restore New England Cottontails to historical ranges SEWD spent 3 days and 2 trap nights to live-trap 8 New England Cottontails from three areas in Sandwich and Mashpee. Two males and one female were provided to the Roger Williams Zoo for a captive breeding program as part of this project. Staff also assisted Joint Base Cape Cod by trapping four N.E. Cottontails at three sites for an ongoing study to assess movement patterns and habitat use. Data was collected from three rabbits which were affixed with radio transmitters in the towns of Sandwich and Mashpee.

District staff also investigated numerous reports of wildlife that were sick, injured or dead as a result of a variety of causes and took the appropriate action, depending on the situation. The Staff also uses this interaction with the public to educate them on wildlife biology and management. The most common species are birds, including gulls, songbirds, waterfowl and other waterbirds; however mammals such as raccoon, fox and opossum are also common along with the occasional reptile. One particularly interesting injured wildlife response occurred in Westport in January 2018 following a major snow and ice storm event. Roughly 15 turkey vultures got caught exposed in the storm, which started as freezing rain and quickly turned bitter cold, and snowed, resulting in the birds being essentially coated in ice and grounded in a weakened condition. We captured many of the birds and transported them to a wildlife rehabilitator for evaluation and treatment. Following a few days of thawing out and feeding, they were released back to the wild.

District staff also operated a number of game check stations during deer and turkey season, collecting biological data used in management of these important game species. DNA samples were collected from a total of 46 deer and provided to Framingham State University for an ongoing research project in relation to the origins of the current deer population on Nantucket. Further, as we have for the past few years, District staff entered all biological deer and turkey data collected into the MassFishHunt online system, allowing for our biologists to review and analyze the data more efficiently. Staff also evaluated a request for a new game checking station in Fall River and ultimately approved the request and trained the employees, filling a signifi-

cant gap in our region.

Fisheries

Pond and stream surveys, using electro-fishing, gill netting, rod/reel survey and other techniques, were completed in a number of southeastern Massachusetts water bodies in FY18 in consultation with the Fisheries Section in Westborough including Red Brook, Cotley River, an unnamed tributary to Deep Brook, Deep Brook, Fall Brook, an unnamed tributary to Sawmill Brook, Purchade Brook, Marstons Mills River, Abigails Brook, Satucket River, Quashnet River, an unnamed tributary to the Winnetuxet River, Bartlett Brook, Wellingsley Brook, Childs River, Weweantic River and Tripp Brook. Passive integrated transponder tagging research on brook trout continued in Red Brook, Quashnet River, Childs River, Coonamessett River, Santuit River and an unnamed tributary to Third Herring Brook.

The District continued our excellent relationship with the Sandwich Fish Hatchery, assisted with a variety of day to day projects, helping to unload feed truck deliveries, inventories of trout, relocation of trout to other raceways and assisting with fall trout spawning.

The District Fisheries Biologist continued our efforts to monitor stream temperature in many southeastern Massachusetts systems including Quashnet River, Mashpee River, Santuit River, Coonamesset River, Red Brook, Weir River, Indianhead River, Childs River, Jones River, Eel River, Wellingsley Brook, Town Brook, Marshfield Fairgrounds Brook, Beaver Dam Brook, Third Herring Brook, Phillips Brook, Furnace Brook, Pocasset River, Rattlesnake Brook, Iron Mine Brook, Marstons Mills River and Snell Brook in order to better manage these systems, warn of dangers or issues, and provide a baseline set of data.

Southeast District staff assisted in placement and operation of three PIT (Passive Integrated Transponder) antennas and solar panels on Third Herring Brook and electrofished and PIT tagged brook trout in a coldwater tributary near the former Tack Factory Pond dam. Third Herring Brook was also electrofished to help document changes in the fish population of the river after dam removals. Trout stocking, electrofishing operations and PIT tagging were filmed and the SE district fisheries manager was interviewed for a video "Letting the Rivers Flow" on the Tack Factory Dam removal produced by the North and South River Watershed Association (https://www.youtube.com/watch?v=-eYFRzTN-qL4&feature=youtu.be).

Stream temperature data collected at ten sites on the Mill River on Martha's Vineyard by the Sea Run Brook Trout Coalition was summarized by the Fisheries Biologist and graphs were produced to provide technical assistance in protecting and restoring this coldwater watershed.

Pond profiles, collecting data on temperature and dissolved oxygen levels, were completed at Little Pond, Ashumet Pond, Hamblin Pond, Cliff Pond, Sheep Pond, Lovells Pond, Mystic Lake, Hathaways Pond, Schoolhouse Pond, Higgins Pond, Long Pond, Gull Pond, Little Cliff Pond, Peters Pond, Pimlico Pond, Mashpee-Wakeby Pond, Fearings Pond and Jenkins Pond.

An electrofishing demonstration and talk on Quashnet River fish and PIT tagging was given to Mashpee Wampanoag Tribal youth attending the Preserving Our Homeland summer camp, as well as the Tidal Quest summer camp and Falmouth High School AP Environmental science class.

A meeting between Trout Unlimited and a Bristol County Community College professor was attended to coordinate possible brook trout genetics work was attended and fin samples were collected from Sandwich State Fish Hatchery brook trout to help the lab develop techniques.

A fish kill was reported at Buttonwood Park Pond in downtown New Bedford was investigated and the cause was determined to be dissolved oxygen depletion associated with a recent lake treatment to control algae.

A poster session for the Environmental Monitoring class at Massachusetts Maritime Academy was attended and feedback was given on posters concerning Red Brook and Century Bog.

Technical Assistance was provided to MIT and the Division of Marine Fisheries in collecting fish from Fresh Pond in Manomet to monitor the restoration of the alewife run in Beaverdam Brook due to the Tidmarsh Farm bog restoration project.

Restoration of the lower bogs and a dam removal on the lower Coonamessett River was monitored and

technical assistance was provided to the town of Falmouth. The southeast District Fisheries Manager has been involved in the Coonamessett River Restoration plans for over 20 years.

A summer intern assisted in fisheries field activities and a winter intern from the Mass Maritime Academy assisted in field activities and data analysis.

The White Island Pond dam was monitored and fish passage provided through the fish ladder when appropriate. Restrictions to fish passage due to vegetation overgrowth of the herring channel was removed to allow fall outmigration of young-of –year river herring.
The bowfin state record was broken twice in the fall of 2017 and the catch was certified at the southeast district office.

The reintroduction of brook trout to the Santuit River was monitored and good over-summer survival and growth of brook trout transplanted from the Mashpee River was evaluated by electrofishing in September 2017. However, no brook trout were noted in a May 2018 survey and temperature monitoring and further research has been coordinated with the Sea Run Brook Trout Coalition, the U.S. Geological Survey and the Woods Hole Research Center.

The fisheries manger attended meetings of the Sea Run Brook Trout Coalition and the Southern New England chapter of the American Fisheries Society.

Land Stewardship
The District Stewardship Biologist completed annual monitoring visits and reports on 30 Wildlife Conservation Easements (WCE) including Camp Cachalot, Watuppa Reservation, Angeline Brook, Santuit Pond, Plymouth Pine Hill West, Sippican Woods, Plymouth Pine Hill East, Plymouth Town Forest, Billington Sea, Taunton River, South Triangle Pond, Brandt Island Cove, Halfway Pond, Stump Brook, APC, Betty's Neck, Betty's Neck Farm, Pilgrim Springs, Angeline Brook, Bread and Cheese Brook, Agawam River, Weweantic River, Agawam Mill Pond Access, Acushnet River, Poor Meadow Brook, Lake Nippenicket, Copicut, Copicut Woods.
Boundary marking efforts continued in FY18, with both in-house and contracted boundary marking work being completed on many properties. The Stewardship Biologist marked boundaries at the Atwood Reservoir WMA (28,022 ft), Maple Springs WMA (2,076 ft) and Copicut WCE (13,964 ft) and oversaw contracted boundary marking at the Atwood Reservoir WMA (8,832 ft), Copicut WMA (49,077 ft) and Taunton River WMA (18,447 ft).

A number of new encroachments were identified in FY18 as a result of these ongoing boundary marking efforts. A possible driveway and retaining wall encroachment was identified at the Bakers Pond Access, however due to a missing concrete bound, it may require a formal property survey to ensure the marked line is accurate. A significant tree/shrub clearing encroachment was identified at Burrage Pond WMA. The situation also involved a potential wetlands violation, so the local conservation commission was also contacted. The Stewardship Biologist successfully worked with the abutting landowner and the Town to remedy the situation and have the area restored. The significant encroachment at Frances A Crane WMA was worked on in FY18, with a formal title research project being planned in order to put the agency in the best position to address the situation. The abutting landowner has long been an issue for the agency, illegally cutting and piling brush/trees on the WMA and building a portion of a horse corral on the WMA.

A new encroachment was identified at our Dartmoor Farm WMA in Dartmouth, where an abutting tree/shrub nursery has built greenhouses and garden/nursery areas partially on the WMA. This was originally flagged during contracted boundary marking and then confirmed via a formal survey due to uncertainties with the property line. The Stewardship Biologist Fee Lands Stewardship Coordinator actively worked on resolving this issue with the landowner and a final resolution is expected to be completed in FY19.

Routine custodial functions continued in FY18 with trash/dumping issues addressed at many properties. Most significant dumping areas include Agawam Mill Pond Access, Rocky Gutter WMA, Frances A Crane WMA, Triangle Pond WMA, Red Brook WMA, Noquochoke WMA, Copicut WMA, Robbins Pond Access and the Hyannis Ponds WMA. Roughly 120 cubic yards of trash was removed and disposed of from Southeast District lands in FY18.

Signs were erected and/or maintained at several properties including Snipatuit Pond Access, Dartmoor Farm WMA, Haskell Swamp WMA and the Black Brook

WMA. Further, a new sign was installed at the District HQ that is in compliance with our new brand and logo. Parking areas and roadways/trails were maintained at a number of WMAs and Access sites including Agawam Mill Pond Access, Snipatuit Pond Access, Haskell Swamp WMA, Dartmoor Farm WMA and Black Brook WMA. Further, a major project to restore a damaged section of the roadway at Rocky Gutter WMA was completed which allows us to provide better access to the general public, particularly during spring and fall hunting seasons, by enabling us to again open the gates on Rocky Gutter Street and allow through traffic. The Burrage Pond WMA and Old Sandwich Game Farm WMA access roadways were raked and graded again in FY18. All of the dike roads and side slopes were mowed at Burrage as well. Further, the reconstruction/restoration of the lost access into Burrage on Elm Street in Halifax progressed in FY18 with OFBA and the District working with the Town planning board to gain approval for the project plans and the actual construction of the roadway and maintenance of the parking area beginning in June 2018. The project was completed in late July.

Gates were installed at the Plymouth Town Forest WCE and Hockomock Swamp WMA.

Fire breaks were created and/or maintained at Camp Cachalot WCE, Frances A. Crane WMA and Southeast Pine Barrens WMA in support of planned prescribed fire management actions at those properties. Further, snags within a specified distance from fire breaks were cut down in accordance with the approved burn plans for each site. Prescribed fires were supported by District staff at a number of properties in FY18 including Frances A. Crane WMA, Southwich WMA, Camp Edwards WMA, Penikese Island Wildlife Sanctuary, Leyden WMA and Muddy Brook WMA.

Herbicide treatments were completed at Burrage Pond WMA (6 patches of Phragmites) and at Frances A Crane WMA South Section (1 patch Japanese knotweed).
A number of hazard tree issues were dealt with in FY18 including two hazard trees threatening a roadway and abutters property on Lisa Lane at the Mashpee Pine Barrens WMA, three pine trees at the Southeast District HQ and a large red maple at the Tispaquin Pond Access.

The Stewardship Biologist attended field training in Sturbridge with Habitat Program Leader John Scanlon to gain experience reviewing forest cutting plans. They utilized an existing forest cutting plan that MassWildlife had some issues with, looked at the actual forest as it was marked out in the field and discussed various ways to avoid future issues with cutting plans on our WCE lands.

The District Supervisor and other District staff continued to deal with two significant land use issues where fishing and boating access points were being used by swimmers/beach goers in violation of OFBA regulations at Bakers Pond in Orleans and Popponesset Beach in Mashpee. A meeting was attended with the Popponesset Beach Association, OFBA and the Environmental Police to attempt to resolve the issue. Ultimately, it comes down to an enforcement issue and, hopefully, with slight changes to the OFBA regulations at the end of FY18, enforcement by both the Environmental Police and Town of Mashpee Police will help in resolving the issue. The Bakers Pond issue arose primarily from an abutter to the access lodging complaints through some high level personnel regarding the use of the access for swimming/beach going, which resulted in the Environmental Police frequenting the site and ordering people using it for swimming/beach going to leave or be ticketed. Consequently, the agency began receiving a large number of complaints from people that have used the area for many years for that type of activity in the summer without conflicts with anglers or boaters. This issue is still ongoing, but we have worked to provide clarity to some folks on how they may use the site or otherwise access the great pond for swimming.
In July 2017, staff worked with MADOT to finalize the restoration of the Hockomock River Access parking area on Route 106 in West Bridgewater following the reconstruction of the adjacent roadway and bridge. MADOT utilized a portion of the parking area as a staging area, resulting in damage to the site and impacts to access. District staff worked with DOT and their contractors to ensure the parking area was left in a better condition than when the project started. Still outstanding on this project however is the agreed to land swap from DOT to MassWildlife in accordance with our agreements under Article 97.

A significant subdivision planned that abuts the Haskell Swamp WMA in Mattapoisett was reviewed and the agency provided significant comments to the Conservation Commission regarding how the project did

not sufficiently comply with regulations.

The District Supervisor worked with agency fiscal staff, the MA Army National Guard and Len Pinaud (Environmental Management Commissioner at Camp Edwards) to evaluate the expenditure of mitigation funds from Eversource. The funds are intended to help prevent illegal vehicular access (primarily OHVs) onto the base and causing damage to the utility ROWs. The plan that resulted intends to use the funds to purchase boundary signage warning of no trespass, pay for contracted boundary marking, purchase several large scale informational signs and purchase some remote camera equipment to aid in enforcement/monitoring.

District staff were intimately involved in the planning and oversight of a significant restoration project at our Frances A. Crane WMA focused on removing approximately 750 downed trees and mulching in place of an additional 900 downed trees that came down in a series of severe winter storms. Staff spent countless hours out clearing downed trees from roadways on the WMA just to allow access and completed tallies of downed trees across much of the site to aid in preparing the RFR for the project. Staff then assisted in conducting sweeps for Eastern box turtles prior to the work being completed each day and monitored the project through completion. One interesting side benefit of this project was that many of the larger downed trees were removed roots and all and transported to be used as large woody debris as part of the Coonamesset River restoration project.

A major ATV/OHV trespass issue continued in FY18 at the Taunton River WMA section abutting Woloski Park. The Stewardship Biologist worked with the Environmental Police, along with installing our remote camera system, to attempt to target some enforcement at the site.

The Mill Brook Bogs and Red Brook restoration efforts continued in FY18 with some significant developments in both projects. At Mill Brook, MassWildlife has now partnered with the Division of Ecological Restoration to revaluate the restoration design and hired a contractor to complete a more thorough analysis of the site and prepare a more landscape level restoration design. At Red Brook, MassWildlife habitat funds were used to purchase biodegradable erosion control matting and over 300 trees and shrubs. District staff spent several long days installing the erosion matting on portions of the stream channel experiencing erosion problems and planted all of the trees and shrubs along sections of the stream banks lacking any shade.

Natural Heritage and Endangered Species

The District cooperated with the Natural Heritage & Endangered Species Program (NHESP) staff on a variety of projects this fiscal year. District staff continued with our increased involvement in coastal shorebird monitoring and management, participating in planning meetings and training sessions, monitoring various plover, tern and American oystercatcher sites, installing and maintaining symbolic fencing and signs and interacting with the public and beach managers on a variety of issues related to shorebird management. Coastal shorebirds were monitored by District staff at Long Island and the South Shore Marshes WMA in Fairhaven, Brandt Island Causeway, Strawberry Point and Angelica Point in Mattapoisett, Fox Island WMA in Wellfleet, Planting Island in Marion and at 10 locations on the Elizabeth Islands.

In spring 2018 SEWD monitored 8 active Bald Eagle nests within Bristol and Plymouth Counties and banded a total of 8 chicks from four of the nests.

TOWN	LOCATION	RESULTS
Lakeville	Anuxanon Island	nest failure
Middleboro	Pocksha Pond	2 chicks banded
Plymouth	Halfway Pond	2 chicks banded
Plymouth	Billington Sea	2 chicks banded
Carver	Sampson Pond	nest failure
Pembroke	Silver Lake	2 chicks fledged
Dighton	Bristol Agricultural High School	2 chicks banded
Westport	Westport River	nest failure

Investigation into leads of seven other possible nesting areas were conducted in the following areas including an aerial survey of the Mashpee area with cooperation from USCG at Joint Base Cape Cod :

N. Wattuppa Reservoir (Fall River), North River (Marshfield), Glen Charlie Pond/Agawam River (Wareham), Robbins Pond (East Bridgewater), Lake Nippenicket (Bridgewater), Hinckley's Pond (Harwich) and Mashpee-Wakeby Pond (Mashpee). No new nests were identified at these locations. SEWD also assisted with

Bald Eagle banding efforts in Suffolk County and Essex County banding chicks at two sites in the towns of Waltham and Amesbury.

In a continued effort to monitor habitat use and identify key nesting areas of Blandings Turtles within the Hockomock Swamp WMA, District staff assisted biologists from MassWildlife's Field Headquarters in trapping and marking Blandings Turtles. In May 2018, staff captured 22 turtles. All turtles were file notched for individual identification and a variety of morphometric measurements were taken. 17 were PIT tagged and 10 were affixed with radio transmitters for tracking. One female was affixed with a gps tracking unit in an attempt to gather detailed movement patterns and habitat use.

Coastal Plain Pond plant surveys were completed at a number of sites including Camp Cachalot WCE, Maple Springs WMA, Plymouth Grassy Pond and several Cape Cod locations.

District staff monitored our five known peregrine nesting sites in Fall River, New Bedford, Brockton, Taunton and Sandwich/Bourne and assisted NHESP staff with banding efforts. Kestrel nesting boxes were installed and/or monitored and maintained at Burrage Pond, Taunton River, Frances A. Crane, Maple Springs and Erwin Wilder WMAs.

The District continued supporting the tern project in FY18, assisting with a wide variety of projects over the course of the year including storing and transporting boats and equipment, the annual tern surveys and habitat improvement projects. District staff assisted with clearing of vegetation on Ram Island in May.

Southeast District supported the annual Northern red-bellied cooter release in May at Burrage Pond WMA.

Enhancement of Outdoor Recreation

District staff stocked its fall 2017 allocation of 12,500 trout into 25 ponds and stocked its spring 2018 allocation of 81,500 trout into 52 ponds and 27 streams. Fall 2017 stocking was completed during the last week of September and the first week of October. Spring 2018 stocking commenced the last week of March and concluded the first week of May. In general, the majority of both fall and spring trout stocking is completed by 4 District personnel, with other staff filling in certain days/routes as needed.

District staff cooperated with Westborough staff to assist in advanced bathymetric mapping of several ponds to support the creation of superior quality pond maps for the general public. Staff surveyed many ponds as part of this effort including Bartlett Pond, Curlew Pond, Fearing Pond, Little Long Pond, Lower Burrage Pond, Mary's Pond, Oldham Pond and Upper Burrage Pond among several others.

The staff provided birds for another safe and successful upland game bird hunting season, stocking 7,912 pheasants on six WMAs and over 12 open covers throughout the District. WMAs stocked with pheasant include Erwin Wilder, Frances A. Crane, Freetown State Forest, Marconi (CCNS), Myles Standish State Forest and Noquochoke. Open local covers include Sandy Neck Beach and Town Conservation Land off Popple Bottom Road in Barnstable, Crowes Pasture Conservation Area in Dennis, Scusset Beach State Park, South Cape Beach State Park, the Shawme Fish & Game Club grounds, the Falmouth Rod & Gun Club grounds, private agricultural land off River Street in Halifax and Middleboro, private agricultural land off Cedar Street and North Central Street in East Bridgewater, and two other portions of the CCNS, near the Provincetown Airport and the eastern edge of Griffin Island in Wellfleet. Also, Waskosim's Rock Reservation, Sepiessa Point Reservation, Manuel Correlus State Forest and Katama Farm are stocked on Martha's Vineyard and 8 locations are stocked on Nantucket.

In addition to Pheasants, staff also stocked 3500 Bobwhite Quail, split evenly between the Frances A. Crane WMA and Myles Standish State Forest WMA. Eight-week-old pheasants were again delivered to the Samoset Rod and Gun Club and the Shawme Fish and Game Club as part of the DFW's Club Bird Program. The District also provided pheasants to the Carver Sportsmen's Club and the Falmouth Rod and Gun Club for use in the DFW's Young Adult Pheasant Hunt, and assisted with the operation of the hunts at both clubs.

The District Supervisor issued permits for a total of 66 special winter game bird hunts, 15 at the Erwin Wilder WMA and 51 at the Frances A. Crane WMA. A total of 345 pheasant and 1,369 bobwhite quail were stocked during these hunts. Two field dog trials were reviewed

and permitted by the District Supervisor at the Frances A. Crane WMA.

The District operated and managed controlled-access hunting opportunities for white-tailed deer, wild turkey, and coyotes at Camp Edwards on Joint Base Cape Cod. These efforts provided hundreds of sportsmen with the opportunity to hunt on roughly 9,500 acres of open territory on the base. A total of 43 deer and 17 turkeys were taken during the regular 2017 deer and regular 2018 turkey seasons, respectively. Further, the District worked closely with base personnel to offer the Division's annual paraplegic deer hunt, with three participants all seeing deer and one deer harvested. The District also worked with base staff to again provide very successful youth deer and youth turkey hunting programs. District staff also supported the implementation of the Blue Hills Reservation Deer Management Plan by assisting with the second segment of the controlled deer hunt.

The District Supervisor attended a meeting with the US Fish and Wildlife Service regarding hunting access on refuge lands. The purpose of the meeting was to attempt to improve sporting access on refuge lands and make said access more consistent among refuges and more in line with State regulations.
The District continued to maintain and improve roads, trails, parking areas and fields on our wildlife management areas and access areas to provide for safe and effective access to our properties for all forms of passive outdoor recreation. The majority of fields and access trails at both the Myles Standish State Forest WMA and Frances A. Crane WMA were mowed and/or maintained by hand cutting.

Outreach and Education
District personnel continued to provide information and educate the general public, as well as a wide variety of other agencies and organizations, through publications and presentations and by attending meetings and events throughout the region. The Division's annual Guide to Hunting, Fishing & Trapping was delivered to all license vendors, State Parks and a variety of other locations throughout the District.

Southeast District personnel prepared and staffed displays at the Marshfield Fair, Standish Sportsmen's Association Sportsman Show, Thornton Burgess Society Animal Day, the Waquoit Bay National Estuarine Research Reserve Watershed Block Party, the Falmouth Rod and Gun Club's Youth Day and several other environmental career days and youth events.

In July 2017 District staff provided an educational field trip with the Wildlands Trust Green Team at the Hockomock Swamp WMA. Students were introduced to the use of radio telemetry through locating Blandings Turtles affixed with radio transmitters as part of an ongoing study of habitat use and movement patterns on the WMA. District biologist also met with the Brockton High School Envirothon team in January 2018 for an interactive presentation and discussion of wildlife biology, wildlife management and the role of MassWildlife.
District staff attended a training/informational workshop in July at our field HQ in Westborough for local Town officials and Animal Control Officers. The workshop was designed to provide information on how to properly deal with bear issues and also to connect Town Officials/Officers from western and central Massachusetts that have extensive bear experience with Town officials from parts of eastern Massachusetts (where we know bears are slowly expanding into) so that they can share their experiences and become better prepared for when bears are more common in the eastern part of the State.

The District Supervisor gave a talk on the American bald eagle at the Sandwich Hollows Golf Club function hall to a group of seniors. The Supervisor also attended several elementary schools career days to talk about his job, as well as giving several general wildlife talks.
District staff assisted with the National Archery in the Schools Program (NASP) by delivering and retrieving course materials and equipment to and from schools in southeastern Massachusetts that participate in the program.

The District Supervisor completed a Hunter Education training and led a full Basic Hunter Education course at the Marshfield Rod & Gun Club in June. He also participated in a workshop put on by Astrid Huseby in Westborough to provide newer hunters with experience and information on field dressing and butchering deer.
Southeast District staff also attended and presented at the Scituate Science Spectacular, the Southeastern MA Chapter of the Ruffed Grouse Society Annual Banquet and the Cape Cod Chapter of Ducks Unlimited Banquet Event. The District Fisheries Manager participated in the Earth Day Trout Stocking Event, stocking fish at Lit-

tle and Long Ponds in Plymouth and giving a brief presentation on trout stocking and fisheries management to the public in attendance.

Technical Assistance

District staff provided technical advice and support to many local Animal Control Officers, police departments, boards of health, and conservation commissions, as well as to the MEP on issues dealing with fish, wildlife, and their habitats. Many of these issues relate to the review of the potential impacts of proposed development projects on fish and wildlife. Others dealt with suburban wildlife and conflicts with humans and with other public health and safety concerns related to fish and wildlife, particularly nuisance or damage complaints and reports of sick or injured wildlife. The District responded to a variety of problem animal calls this fiscal year, predominantly dealing with coyotes and aggressive wild turkeys. Numerous site visits were made to meet with concerned citizens and information was provided to either quell their concerns or empower them to take steps to reduce the probability of conflicts such as proper yard maintenance, harassment and pet husbandry.

Numerous nuisance and aggressive turkey complaints were again reported during FY18 in the District. Most notably, working in conjunction with the local Police Department and Animal Control in the town of Fairhaven, two aggressive adult male turkeys were removed due to ongoing public safety issues at a local school. One adult male was removed from a neighborhood in Seekonk following repeated incidents of aggression at a bus stop.

In FY18 SEWD staff responded to numerous reports of aggressive hawks. Site visits were conducted in extreme cases in the towns of Mansfield, West Barnstable, Middleboro, Plymouth and Sandwich. Three Red-Shouldered Hawk chicks were removed from a nest in West Barnstable to be fostered into nests at alternate locations in an effort to alleviate a public safety issue. Broad-Winged Hawk and Red-Shouldered Hawk nests in the remaining towns were either removed or scheduled to be removed once the chicks fledged in an attempt to deter nesting at those sites and to promote future nest sites in more suitable locations.

In response to a diesel fuel spill from a fishing vessel in New Bedford Harbor in August 2017, staff spent three days working in conjunction with the United States Cost Guard and Fairhaven Animal Control to capture a total of 13 Mallards, 1 American Black Duck and 1 Black-Backed Gull that had been impacted by the spill. Fuel saturated birds were taken to Cape Wildlife and Wild Care for rehabilitation and release. Staff also provided technical assistance to the USCG and Falmouth DNR during a second oil spill that occurred in Wood Hole in January 2018 that impacted over 20 birds, primarily sea ducks.

The District had staff that served as the MassWildlife representative on a variety of management teams and efforts including the Santuit Pond Preserve Management Team, the Assawompset Pond Complex Management Team, the Lyman Reserve/Red Brook Management Team, the Southeastern Massachusetts Bioreserve Management Team and the Mashpee National Wildlife Refuge Management Team. The Fisheries Biologist was actively involved in monitoring the Massachusetts Military Reserve (MMR) cleanup activities as a member of the Plume Containment Team.

District personnel were involved in two Large Animal Response Team (LART) events in FY18, both involving white-tailed deer. In November, staff responded to reports of two deer stuck inside an abandoned power plant property in Somerset. The two deer were located, both adult males, and a plan was developed to leave a side gate for the facility open in the evenings to allow the deer to leave on their own accord, which was successful. The second event involved a yearling male deer that had jumped through a glass window into the Brockton VA Hospital. The deer was caught and dragged outside the hospital by local animal control prior to MassWildlife and OLE arrival; however the deer escaped into an enclosed courtyard area with a catch pole still attached to its neck. MassWildlife and OLE successfully darted the animal, removed the catch pole, treated it for minor injuries sustained during the jump through the window and transported it to a local WMA for ear tagging and reversal/recovery. The deer recovered and walked off into the forest in apparently good condition after being given the reversal drugs.

District staff responded to a request by the Halifax Police Department looking for information on where to aim to safely and effectively euthanize common wildlife species that they encounter by preparing a slide show presentation with photos and other information to guide the officers in the field.

The District Supervisor attended monthly meetings of

the Barnstable, Bristol, and Plymouth county leagues of sportsmen, providing them with information on DFW activities and answering fish and wildlife questions.

Central District

Administration
Central District staffing was stable through FY18 with the exception of the retirement of long time District Supervisor Bill Davis. Todd Olanyk started in June of 2018 as the new Central District Supervisor. All other current staff positions have been filled with the same personnel for a minimum of three years, with some of the team in place for more than a decade. This continuity of experience enhances the efficiency of District activities in that the entire group are aware of the annual cycle of work and require less direction.

Bill Davis had been with MDFW for over 30 years and served in a number of positions including outreach and media liaison. He also wrote and published the MA Wildlife Viewing Guide in 1996. He was instrumental in the agencies work on Bald Eagle restoration taking over as project leader in 1988. Bill served as Central District Supervisor since the mid-2000's. He retired on April 30, 2018. The position was filled by Todd Olanyk who took over on June 10th, 2018.

The District Supervisor and the District Biologists provided input to DFW Lands Committee on potential land acquisition projects, focusing on wildlife habitat and recreational opportunities. The District Stewardship Biologist and Wildlife Technicians monitored Conservation Easements throughout the District.

License agreements were issued by the District for agricultural leases on WMAs. The District currently manages 33 agreements. These agreements benefit wildlife by maintaining open habitats, often in places that would otherwise not be actively managed due to staff, equipment, and time constraints.

Staff participated in professional development and training including: Wildland Fire Training, and Large Animal Response and Safe Capture Training.

Research and Conservation
Wildlife
Four research bear trapping sites were operated; two individual female bears were captured. A total of seven collared research bears were monitored during FY18, and we conducted four bear den site visits during the winter to assess the health of the bears and cubs they produced.

A total of 144 wood duck boxes were checked and maintained at 34 sites throughout the District. 37 new boxes were erected.

In the early summer of 2018 we banded 150 Canada Geese at 13 sites. This number is comparable to our annual goose banding efforts from perivious seasons.

Central District staff collected biological data at 9 deer check stations, 7 turkey check stations, 6 coyote check stations, and 2 bear check stations durig the respective seasons.

We also assisted in waterfowl breeding plot surveys, Ruffed Grouse drumming surveys, and Woodcock surveys.

Fisheries
District staff surveyed 45 sites on the Millers, Nashua, Concord, French and Chicopee drainages during the months of July, August and September. The surveys conducted using electro shocking equipment gathering information on fish identification, lengths, dissolved oxygen, ph, conductivity & temperature.

District staff surveyed 10 waterbodies using electro shocking equipment to determine species, length and weight. Staff surveyed 7 Waterbodies with Total Warmwater species pickup at East Wauschacum & West Wauschacum Ponds in Sterling, Wampanoag Lake in Gardner & Ashburnham, Lashaway Lake in East Brookfield, Moosehorn Pond in Hubbardston, Tully Lake in Royalston, and Little Pond in Bolton. Staff surveyed 3 Waterbodies with Total Coldwater & Warmwater species pickup at Webster Lake in Webster, Quinsigamond Lake in Worcester and Wachusett Res. in Boylston and West Boylston.

District staff conducted Lake Trout sampling on Quabbin and Wachusett Reservoirs, setting gillnets for Age and growth rates.

Westminster Business Park & MBTA proposed layover station impact on 2- unnamed tributaries that flow to

the Whitman River in Westminster with water flow devices that record temp. oxygen and conductivity for fish survival.

District staff continued oversight at Bartlett Pond in Lancaster to reintroduce wild eastern brook trout into the lower section of Wekepeke brook to the Nashua River.

Staff are continuing work with Army Corp. of Engineers on retaining wall reinforcement for Wild Brook Trout habitat on Slack Brook in Leominster.

There was also continued oversight on Cooledge Brook in Berlin and oversight in Northborough on an issue with water quality to sustain native brook trout.

Land Stewardship

The District Stewardship Biologist completed 29 WCE/ WCR Monitoring visits ensuring compliance.

We also reviewed two land owner cutting plans WCE/ WCR properties.

Throughout the year maintenance work was performed on all WMA sign kiosks. There are well over two hundred in the District. Signs were refreshed and damaged or missing kiosks were replaced. In addition, Sixteen gates were cleaned and painted.

We continue to work with our boundary contractor to mark all WMA boundaries so they are clearly identifiable as publicly accessible. To that end we monitored all of the district WMA's for compliance to regulations and for encroachment issues. There were six encroachment problems that were dealt with in FY18, some requiring assistance from the MA Environmental Police to resolve. We removed trash from illegal dump sites at three WMA's.

Two staff members participated in annual fire refresher training and assisted on a successful prescribed burn at Muddy Brook WMA.

District staff worked with our habitat program staff to plan and review three major timber harvesting operations on the Birch Hill, Muddy Brook, and Quaboag WMA's. These timber sales are slated for FY19. We also worked on boundary marking in areas where abutting property owners were conducting timber cuts to proactively avoid encroachment problems.

We added Safety Zone marking at three WMA's; Muddy Brook, Winimussett, and Quaboag. These pheasant stocked areas are adjacent to nearby residences and this marking will enhance public safety and ensure continued stocking efforts at these locations.

Dam maintenance and cleaning is a continuous effort. Although there are many small dams that the agency has jurisdictional ownership of in the Central District, much of our time in FY1 was spent at Wine Brook, Williamsville pond, Cusky pond, and the Merrill pond systems. Extensive clearing of brush and small woody growth was completed at the dam on Adams pond, as well as the addition of rip rap to re-enforce the area around the spillway there.

District staff conducted habitat reclamation work on Moose Brook and Raccoon Hill WMA's. The Moose Brook effort was in partnership with the National Wild Turkey Federation. This partnership resulted in creation of early successional habitat and a much improved parking area for better access.

The District Stewardship Biologist worked with COOP farmers on active agricultural lease properties to the farmers were following the requirements of their lease agreements.

Natural Heritage and Endangered Species

District staff monitored 14 active bald eagle nests. Eleven of these pairs successfully reproduceed a total of 21 chicks. We banded 12 of these chicks at six nest sites.

Two peregrine falcon nesting sites were monitored within the district; one in Worcester, and another in Leominster. Our staff assisted NHEP Staff in that effort.

Staff assisted NHESP section staff to enhance spadefoot toad habitat at an existing site in Wayland.

Enhancement of Outdoor Recreation

Trout were stocked with approved spring & fall allotment numbers. A total of 81 waterbodies received trout with 39 Ponds, Lakes & Reservoirs, 22 Rivers & 20 Streams. Overall 95,430 trout were released with six staff members working full time on this effort from 3/12-5/30 2018. Hatcheries in Belchertown, Sunderland, Montague & Sandwich supplied the Trout.

Central District staff stocked 12,900 adult pheasants at 19 properties (16 WMA & 3 DCR). We also have nine sporting clubs and two jail locations participating in the club bird program. These locations were delivered 5,448 pheasant chicks that were reared and subsequently released onto publicaly huntable grounds throughout the district.

Outreach and Education

The District Supervisor attended the monthly meetings of the Worcester County League of Sportsmen providing highlights of district activities and interacting with meeting participants. A monthly report of these activities was also generated and distributed.

District staff participated in the agency Open House event held at FHQ.

We also assisted with the head start red bellied cooter turtle project by supplying holding tanks for the collection and liberation events at FHQ.

District staff conducted a presentation on Backyard Wildlife for the New Braintree library.

The Stewardship Biologist provided assistance for soil pit excavation at headquarters for the annual Envirothon event. This task requires backhoe operation and specific knowledge of OSHA regulations to ensure safety.

We provided stocked tagged trout on the Mill River as part of the state tagged trout program. The Polish American Club in Blackstone was the sponsoring entitiy for their annual Fishing Derby.

We also conducted trout stocking events with local interest groups including N.E. Flytyers, Cub Scouts, Boy Scouts, local High School students, and a daycare facility in Phillipston.

District staff provided assistance to the American Chestnut Foundation at orchards located at the Westborough FHQ and the Central District office; Brush hogging, rototilling, pruning and tree removal work were completed on this ongoing project.

Connecticut Valley District:

Administration

The Connecticut Valley District saw some significant changes in personnel during FY2018. The District Supervisor, Ralph Taylor, retired after 34 years of service with the Division. Ralph's career started at the McLaughlin Fish Hatchery in 1984 as Assistant Fish Culturist. Over the years his influence and guidance was instrumental in shaping the district into what it is today. Alex Krofta was hired on August 7th, 2017 to fill the vacant Stewardship Specialist position. Alex comes to MassWildlife with nearly a decade of experience in rare species field research, habitat management, and conservation land stewardship. He received masters' degrees in Environmental Science and Policy from Clark University, and Ecological Landscape Planning and Design from Conway School. Alex has proven to be a valuable addition to the Connecticut Valley District Staff.

Barbara Bourque, longtime District Clerk retired in early 2018. She was among the first District office clerks to be hired in the 1990's. In May of 2018, Anne-Marie Bartus was hired to fill the Clerk position. Thanks to Barbara for her service and a warm welcome to Anne-Marie!

The District Supervisor and District Biologists provided guidance and input to the DFW Lands Committee on 15 new land acquisition projects. These acquisitions will serve to protect critical wildlife habitat and provide recreation opportunities for outdoorsmen and women throughout the district. This year a total of 863 acres of new property were acquired to either expand existing Wildlife Management Areas (WMAs) or create new ones.

Agricultural licensing agreements were issued on 15 Wildlife Management Areas (WMAs) in FY18. These agreements are allowed and maintained when they provide a benefit to wildlife by maintaining open space habitat in places that would otherwise not be actively managed due to staffing, equipment and time constraints.

Working collaboratively with the Department of Conservation and Recreation (DCR), Valley District staff sold 2,722 Quabbin One Day Fishing Licenses. These licenses were issued at the three boat launch areas on the Quabbin Reservoir and totaled $13,610 this fiscal year.

The Swift River primitive camping area continues to grow in popularity. This fiscal year 36 Swift River Camping permits were issued, up 80% from last year!

There were no Field Trial or Special Pheasant Hunt permits applied for, requested or issued in the Valley District this FY.

Valley District staff participated in professional development and training throughout the year including: prescribed fire certifications, pesticide applicator's license, boater safety training, Large Animal Response and Safe Capture training and attended workshops and conferences.

Research and Conservation

Wildlife

Valley District staff completed 5 Ruffed Grouse drumming survey routes, 6 deer pellet transects and contributed to this year's Wild Turkey brood survey. Staff also banded 100 Canada Geese at seven sites. A total of 118 Wood Duck boxes were checked and maintained at 35 sites. Favorable ice conditions this year allowed for good access to maintain boxes that have not been checked in several winters. Blue Bird and Kestrel nesting boxes were maintained at several WMAs as well.

Valley District staff monitored the survival and reproduction of 18 radio-collared black bears (2 males and 16 females) during this reporting period. Two collared adult reproducing females were harvested during the hunting season and the 2 collared males dropped their radio collars. Attempts were made to capture 13 collared females in their dens to determine reproductive success and first-year cub survival, but only 8 of the females were captured. It was determined that 5 females had newborn cubs, 4 had yearling cubs, and 4 did not produce cubs. Global Positioning System (GPS) collars were affixed to bears to monitor locations every 45 minutes. Eight bears (7 males, 1 female) were trapped during June of 2018 to increase the sample of GPS radio-collared females. During the fall of 2017, 3 GPS collared females made unusual movements outside their normal home ranges, 2 traveled nearly 40 miles north of their home range. It is possible that these movements were related to the larger than average beechnut crop in northern Massachusetts, southern Vermont, and New Hampshire which attracted bears from greater distances than typically observed.

The Valley District office in Belchertown continues to be staffed to check all harvested game species that require reporting. In addition, there were eight deer, seven turkey, three bear, and three furbearer check stations set up throughout the district to make checking hunter harvested animals more accessible to hunters. The district also staffed four biological deer check stations during the first week of the shotgun deer hunting season.

Valley District staff continues to clear and maintain the 1.25 miles of access trails to four duck blinds for the annual Ludlow WMA controlled duck hunt. This year 5 groups of hunters participated in the district drawing to participate in this hunt.

Fisheries

Aside from trout stocking, Valley District staff led and participated in a number of field sampling projects in FY18. Because the annual FY spans from July to June of the following year, this report will include activities in 2017 and partially covers the beginning of the 2018 summer sampling season.

The 2017 summer sampling season started in July of 2017. Valley District staff sampled a wide variety of large rivers, ponds and smaller streams. Staff completed 18 electro fishing surveys off the annual priority list. Congamond Lakes were also sampled, as in past years, as part of a recurring annual warm water electrofishing survey. As in the past 2 years, larger river systems within the district were sampled in cooperation with Field Headquarters staff (FHQ). In this reporting period, samples where completed for multiple locations on the following rivers: Quaboag river, Chicopee River, Ware River and Swift River. Surveys involving such large bodies of water involve large scale efforts, with either large backpack crews consisting of 4 to 5 shocking units and up to 12 people, or boat shocking with one or two shock boats working in tandem.

Starting in August 2017 Valley District staff worked with FHQ and the US Fish & Wildlife Service on a new project on the Connecticut River assessing juvenile shad populations. Multiple nights per week between August and October, crews would electrofish several reaches of the Connecticut River to collect juvenile shad and review their relative population densities. This work is planned to continue as part of a multi-year survey, but the initial findings from 2017 are outlined in the following report (http://www.fws.gov/r5crc/pdf/MDFW_USFWS_Shad_Assessment_4_20_18_final.pdf)

Valley District staff continues its efforts to support the Quabbin Lake Trout project. Similar to last year, the District Fisheries Biologist led crews on 7 night surveys. Sampling efforts ran from October 26th to November 21st, and consisted of approximately 5 staff members and one shock boat. During the survey, staff sampled 186 lake trout, 33 of which were recaptures from the previous years. New passive Integrated Transponders (PIT tags) were implanted into first-time captures. Additionally, otoliths were removed and used to establish age of incidental mortalities.

Image 1-1: Valley District Staff and DFG Commissioner Ron Amidon conducting Quabbin Lake Trout survey project.

This year staff also took the initial steps in implementing an additional new project on the Swift River. A very basic mark-recapture study for stocked Rainbow Trout within Swift River was started in June of 2018. Valley District staff fin clipped all Rainbow Trout stocked above Route 9 in the "Fly Fishing Only" area. Crews plan to return and backpack shock all Rainbow Trout in this stocked area and ascertain the proportion of marked fish encountered, at one week and one month post-stocking. The hope is that this information can lead to a better understanding of fish movement in this popular river, and set the groundwork for more serious research in the coming years. Initial recapture efforts will begin in FY19.

There were two sizable fish kills reported at the Hamilton Reservoir in Holland on April 17th and May 2nd, 2018. Valley District and FHQ staff visited the site and initial field observations indicated that these fish kills were attributed to natural factors within the pond. District staff will continue to monitor the situation and investigate any further activity as needed.

Land Stewardship

Boundary marking of WMAs continues throughout the district. This year in the Connecticut Valley District a total of 22 miles of WMA property boundary lines where marked. Many of the marked boundaries were on new acquisitions, including parcels at: Brewer Brook WMA, Montague WMA, Flagg Mountain WMA, Brushy Mountain WMA, East Mountain WMA, Southwick WMA, Montague Plains WMA, and Herman Covey WMA. While agency staff did some of this work, contractors were used to complete large and/or complicated boundary tracks when funding was available. In addition to contributing to boundary marking, the contractors also helped out by reporting encroachments, conflict with abutting landowners, and other issues they encountered while in the field.

Despite a late start this year, annual monitoring visits and reports were conducted on 35 Wildlife Conservation Easements (WCE) throughout the district in FY18. Annual monitoring is a legal obligation under the terms of each easement, and is also critical to protecting the conservation values of these properties. Each landowner participating in a WCE was contacted and invited to join staff during the site visit. Participants who decided to come along for the site visits provided a good perspective on the land's history and current use, as well as, a chance to build relationships with these landowners.

Three gates were installed at Montague Plains WMA by the Valley District staff to further help deter illegal trash dumping and reduce illegal off highway vehicle (OHVs) access. Remote camera systems were also deployed as needed to monitor and document illegal activities. Photos of offenders were provided to Massachusetts Environmental Police who patterned activity and issued several citations. These efforts have contributed to a marked reduction in illegal dumping seen at this property.

All WMAs were posted with rules and regulations. Signs are posted at public access entrance points at 35 WMAs throughout the district.

Approximately 150 acres of fields were mowed at six WMAs (32 acres at Southwick WMA, 15 acres at Southampton WMA, 70 acres at Herm Covey WMA, 13 acres at Poland Brook WMA, and 20 acres at Leyden WMA). Additionally, several firebreaks were mowed and/or maintained at Montague Plains WMA, Southwick WMA and Leyden WMA for future prescribed fire management on those properties. Two district staff members certified to work on controlled burns assisted with prescribed fires throughout the state, including 3 within the Valley District. In total 200 acres of grassland or scrublands were burned with prescribed fire (100 acres at Southwick WMA, 65 acres at Montague Plains WMA, and 35 acres at Leyden WMA).

Under the agency's current Walking Trails Policy, proposed trails and maintenance of exiting trails must undergo and in-depth application and approval process. The Valley District has been working with Appalachian

Mountain Club (AMC), the Town of Amherst, and North Quabbin Trials Association to bring sections of the New England Trail, Robert Frost Trail, and the Tully Trials into compliance with this policy.

Natural Heritage and Endangered Species

The District cooperated with the Natural Heritage & Endangered Species Program (NHESP) staff on a variety of projects throughout the district this year. Valley District staff assisted FHQ staff with Eastern Box Turtle, Timber Rattlesnake and Whip-poor-will surveys within the district.

The Valley District staff continues its efforts to monitor and band eagle census covering Hampshire, Hampden and Franklin Counties. District staff identified and monitored 30 breeding Bald Eagle territories and banded eaglets in trees that could be safely climbed.

Enhancement of Outdoor Recreation

The 2017 fall stocking season ran from Oct. 2nd-16th, 2017. This shorter season was comprised of 10 stocking runs, completed by one stocking truck with two staff members each day. A total of 12,500 Rainbow Trout and 1,000 Brown Trout were stocked. All Rainbow Trout were sourced from the McLaughlin Hatchery in Belchertown, and Brown Trout from the Bitzer Hatchery in Montague. All Brown Trout from this allocation were stocked into the Millers River as part of a special cooperative stocking effort with Trout Unlimited. Rainbow Trout were stocked in 33 waters, which included 6 of our more favorable rivers and 27 ponds and lakes.

The 2018 spring trout stocking season began on March 20th, and ended normal season stocking runs on May 31st. As in years past, the Swift River received one additional out-of-season "holiday" stocking around July 4th. A total of 99 water bodies were stocked during the spring season, which included 30 lakes/ponds and 69 brooks/rivers. The district stocked a total of 99,880 fish in the normal spring season, totaling 77,574 pounds. This total was comprised of 25,770 Eastern Brook Trout, 54,660 Rainbow Trout, and 190 Tiger Trout. The majority (64.85%) of spring stocked fish were 12 inches or greater, with 14 inch Rainbow Trout making up the bulk of stocked fish. Spring stocking was accomplished through the use of two 2½-ton fish stocking trucks, each operated by two district staff. The "holiday" stocking of the Swift River took place on June 29th this year. As a tail water river, the Swift is able to maintain adequate cold-water temperatures throughout the year allowing for this summer stocking when many other waterways are too warm. In 2018 the summer stocking of the Swift River consisted of 1,955 (3,098 pounds) Rainbow Trout over 14 inches in length. Fish were sourced from the McLaughlin Hatchery and distributed throughout the river in 3 separate loads.

Valley District staff stocked 10,000 pheasant on 10 agency owned WMAs, 6 government properties, and 12 privately owned hunter accessible properties prior to and during the 6-week long pheasant-hunting season. The WMAs stocked by district staff this year included: Herm Covey WMA, Poland Brook WMA, Leyden WMA, Montague Plains WMA, Connecticut River WMA, Bennet Meadows WMA, Pauchaug Brook WMA, Southampton WMA, Southwick WMA and Whateley Great Swamp WMA. Tully Mountain WMA was also stocked this year by local clubs as part of the districts Club Bird Program. Towns stocked within he district included: Amherst, Belchertown, Brimfield, Conway, Deerfield, Gill, Hadley, Hatfield, Holland, Brimfield, Leverett, Leyden, Montague, Northfield, Northampton, Orange, South Hadley, Southampton, Southwick and Whately. A complete list of pheasant stocked properties within the district can be found on MassWildlife's website at: https://www.mass.gov/service-details/pheasant-stocking-connecticut-valley-district.

Six sportsmen's clubs within the Valley District participated in the Club Pheasant Program this year. District staff received and distributed 1,576 seven week-old pheasants to these clubs in July. These birds will be released on properties open to public hunting during the regular hunting season for sportsmen and sportswomen to enjoy.

Valley District staff administered the annual controlled waterfowl hunt at Ludlow WMA. Five groups of hunters applied for this years raffle style permits and all five were drawn to participate in the hunt.

Outreach and Education

Valley District participated in the Franklin County Fair again this year by manning a MassWildlife display over the four-day event. Field Headquarters staff (FHQ) assisted and provided river fish shocked at the Oxbow on the Connecticut River for the Fish and Game buildings display tanks.

Valley District staff also provided a presence at the Springfield Sportsmen's Show in West Springfield, selling licenses, stamps, and permits and answering questions from the visiting public.

During the spring trout stocking season, Valley District staff participated in several public stocking events, including events with several new partners. The majority of these events took place during the week of spring break when children are out of school and available for events. This week coincides with Earth Week.

In mid April, Valley District Staff worked collaboratively with West Springfield's Park and Recreation Department to stock Piper Brook Pond in West Springfield as part of a fishing derby hosted by the town.

A new informal event this past season took place at the Lucy Stone Park along the Quaboag River in the town of Warren. Valley District staff met with the local Boy Scout Troop to help stock the river. This event was in recognition of the troop led restoration of the park in the prior year.

Similar to last year, MassWildlife advertised a small informal stocking event during Earth Week in each of the 5 districts. The Valley District hosted this year's stocking event at Holland Pond in Holland. The time and location of the stocking was posted both online and in print a few weeks prior to the event, and the public was encouraged to attend. Attendees helped district staff stock Brown Trout into the pond.

Another small stocking event took place at Dragon Brook in Shelburne. Children and their parents helped stock Brook Trout and were given a brief presentation about our stocking program and fisheries in general.

The Eagle Brook School of Deerfield visited the McLaughlin Hatchery for a spring fieldtrip and helped stock the Swift River with district staff. Students leaned about water ecology and had a chance to release some large Brown Trout into the Swift River.

District staff continued their partnership with professor David Christensen of Westfield State University. Staff led 2 days of field demonstrations utilizing boat and backpack electrofishing, and provided a guest lecture at the university.

The District Supervisor attended regular meetings of the Hampden County Sportsmen's Council, the Hampshire County League of Sportsmen, and the Franklin County League of Sportsmen where he gave various presentation of interest to these groups. The District Supervisor and the District Biologists participated in various meetings with federal, state, and local agencies and land trusts, focusing primarily on land acquisition, management, and informational talks.

Technical Assistance

Our district offices are often our first line of contact to the general public. As such, the Valley District staff fielded hundreds of calls requesting technical assistance regarding wildlife and fisheries concerns. Staff also addressed the needs of walk-in visitors ranging from hunting and fishing license sales, requests for information, and provided assistance with nuisance-animal complaints. District personnel were often called upon to provide technical assistance to other agencies or user groups. Numerous injured hawks and owls were transported to rehabilitators. Additional field responses included assistance sought on behalf of deer, moose and bear.

Western Wildlife District

Administration

The Western District had no staffing changes in FY18. Two wildlife technicians missed considerable time in the second half of FY18 with back injuries. We did our best to compensate for the lost time with help from the Westborough Field Headquarters and interns from the Massachusetts College of Liberal Arts and the University of Massachusetts.

The District Manager participated in the land acquisition process by attending two parcel meetings, touring and assessing land projects, and assisting in project coordination. Fourteen projects totaling more than 1300 acres, across 12 towns were protected in the Western District. It was an excellent effort by Western District Land Agent Peter Milanesi and the rest of the acquisition team.

We renewed agricultural License Agreements in FY18 on the Hiram Fox WMA in Chesterfield and Eugene Moran WMA in Windsor. The District currently manages 15 agreements to benefit wildlife habitat.

Staff participated in professional development and training including: Wildland Fire refresher, SCUBA Dive Team Training, Chainsaw Safety, Emerald Ash Borer Management, and Large Animal Response.

The District manager coordinated an access improvement effort to the Three Mile Pond WMA in coordination with Ducks Unlimited, Office of Fishing and Boating Access, and The Outdoor Heritage Foundation. The project is scheduled for completion in early FY19.

Research and Conservation

Wildlife

Annual surveys for Woodcock, Ruffed Grouse, and waterfowl were conducted in cooperation with Wildlife Section biologists at FHQ. Staff also cleaned, constructed, and installed nest boxes for Wood Duck, Bluebird, and Kestrel.

Western District personnel provided support for Wildlife Project Leaders through game check stations, kill-card data entry, goose banding, and habitat work. Rabbit pellet collecting efforts continued in FY18. Samples were collected in January of 2018 as part of the search for New England Cottontail. District staff completed 4 deer pellet surveys in cooperation with Westborough FHQ.

The District deployed loon rafts at Cleveland Reservoir in Hinsdale and Buckley-Dunton Pond in Becket. The Cleveland raft was used successfully with one chick hatching in June of 2018. This is the first known loon hatching in Berkshire County.

The District had continued success with the bear trapping and collaring program. We collared 6 new sows bringing the total number of monitored bears to 8. This information has been useful in determining bear home ranges and use patterns in the Western District. The District Manager responded along with the Massachusetts Environmental Police to a reported bear human contact in the town of New Marlborough. The contact came as a homeowner was trying to haze an adult male bear from his fruit trees. The bear ran at the homeowner and made contact with his right arm then ran in to the woods. The homeowner had a minor superficial scratch to the right arm but was otherwise unhurt. There was no further sign of the bear.

Fisheries

A total of 64 fisheries surveys were conducted on 24 rivers and streams in the Western District from July to September 2017. All the surveys, except one, were conducted using electrofishing equipment; the majority of the surveys utilized backpack electrofishing gear. Barge electrofishing gear was used to survey some of the larger rivers such as the Hoosic River and Housatonic River. The exception was a minnow trap survey conducted on Hop Brook in Tyringham, as the stream channel was too deep to effectively electrofish. Four major rivers were surveyed at various locations during the summer with assistance from Field Headquarters' fisheries crew: Hoosic River, Housatonic River, West Branch Farmington River and mainstem of the Westfield River. Two new Coldwater Fisheries Resources were identified as a result of this season's sampling; Rocky Brook in Chesterfield (SARIS 3211475) and Finley Brook (UNT to Walker Brook) in Chester (3210335). Of all the surveys conducted, only 1 survey yielded no fish.

Six lake and pond surveys were conducted by boat electrofishing between June 6 and 19, 2018; Ashfield Pond (Ashfield), Big Pond (Otis), Buckley-Dunton Reservoir (Becket), North Pond (Florida), Pontoosuc Lake (Pittsfield/Lanesborough), and Upper Highland Pond (Goshen). All fish were measured to the nearest millimeter and weighed to the nearest gram before being returned to the water.

The District Fisheries Biologist and technicians continued to monitor for the presence of Didymosphenia geminata (a.k.a Didymo) in two river systems in the Western District. They also assisted in inventory of freshwater mussels in the Farmington River.

The District manager and Fisheries Biologist assisted the Fisheries Section in adipose clipping of brown trout for stocking in the Deerfield River. Clipping will help identify between stocked fish and wild reproduction.

We re-initiated a program to remove invasive water chestnut (Trapa natans) from Three Mile Pond in FY18. The shallow, eutrophic nature of the pond makes it particularly susceptible to water chestnut which would have deleterious impacts on rare species and recreation. Removal is done through hand pulling and will require years of consistent effort to eradicate.

District personnel provided support for the Fisheries Section by providing technical information, consulting on environmental review, responding to fish kills, and participating in meetings. The district fisheries staff maintained informational signage on the 3 designated Catch and Release areas in the Western District.

Land Stewardship

The Stewardship Biologist is responsible for coordinating efforts on boundary marking, encroachments, access, Conservation Easement monitoring, and other land management activities. The Stewardship Biologist was the point of contact for contractors working on boundary marking and surveys. A total of 39 miles of boundaries were marked in FY18, in combined efforts between district staff and contractors. Property surveys were conducted on two Western District WMAs. Much of the Boundary effort focused on the 5000+ acre Fox Den WMA in Middlefield/Chester/Worthington.

The Stewardship Biologist coordinated 31 visits to Conservation Easements. The Biologist reviewed multiple forest management plans for operations on Conservation Easements.

The District continued habitat projects on Wildlife Management Areas. We restored field habitat on the Peru WMA. The area had been converted from forest to field in 2005. Our efforts in FY18 will bring the area back to its 2005 status and provide habitat benefit to a variety of species. We also used 2 tractors and the District Skidsteer to restore fields at the Jug End Wildlife Management Area and State Reservation in Egremont. District staff used chainsaws and pruning saws to release apple trees on the Peru WMA, continuing a project started in FY17.

District technicians maintained open-field habitat on approximately 200 acres through summer mowing. This requires approximately 100 personnel days from mid-July to October.

District Staff maintained parking areas at 12 WMAs, installed gates at the Hinsdale Flats WMA and worked with a local resident to resurface a parking area at the Stafford Hill WMA.

We spent considerable time clearing vegetation from the Three Mile Pond Dam. The dam is an 800' long earthen structure owned by MassWildlife which requires significant personnel time to keep in compliance with allowable standards. Multiple days of work were also required to clear beaver activity from the outlet structure.

The Stewardship biologist developed specification sheets for land survey bids and provided deed research, survey plans, and property maps to boundary marking contractors.

Natural Heritage and Endangered Species

District biologists provided support in the form of local knowledge and biological input to the NHESP on environmental reviews and listed-species issues. The District Manager and Fisheries Manager have been involved in review of the lake and pond drawdown activities in the Western District. We plan to continue to work with NHESP and the Fisheries Section on this effort.

District staff participated in the Bald Eagle Nesting Survey. There are 7 active nests known in the Western District: Russell, Pittsfield, Lee, Monterey, Buckland, Richmond, and Otis. Chicks were banded at the nests in Richmond and Russell.

We decided to delay winter bat counts in the mine hibernacula until FY19 to reduce disturbance. We conducted surveys in 3 small cave hibernacula in FY18.
District Biologists and Wildlife Technicians partnered with NHESP to manage and enhance habitat for endangered bog turtles by conducting surveys, clearing habitat, maintaining water levels, and assisting in the management of beneficial grazing.

Enhancement of Outdoor Recreation

Enhancement of outdoor recreation is a core function of the District office.

Fall trout stocking ran from October 3-12, 2017, for a total of 7 stocking days. Seventeen waterbodies were stocked; 16 lakes and ponds and 1 river (Deerfield River). The East Branch of the Westfield River was not stocked during the fall stocking season due to low water conditions and high water temperatures. A total of 12,418 trout (from Bitzer, McLaughlin and Sunderland hatcheries) were stocked in Western District waters during the FY18 fall season.

FY18 Spring trout stocking commenced on March 28,

2018 and concluded on May 21, 2018, for a total of 45 stocking days. Seventy–seven waterbodies were stocked during the spring season; 23 lakes and ponds, 54 rivers and streams. The total number of fish stocked in the spring was 88,893 from all five Division hatcheries: Bitzer, McLaughlin, Sandwich, Sunderland and Roger Reed. Rainbow Trout in the 14+ category from McLaughlin Hatchery were the most frequently stocked.
Trout stocking is the primary activity for District staff through the spring months. Approximately 180 personnel days were spent delivering trout. Work was performed primarily by District staff with assistance from a seasonal intern from Mass College of Liberal Arts, hatchery staff, Westborough Fisheries Seasonal Technicians and other Westborough staff.

Heavy snowfall and cold temperatures in Western Massachusetts led to late ice out on several ponds requiring later stocking efforts for those waters. However, late spring river water levels remained higher than in the previous 2 years, creating excellent conditions for later season stocking of the Westfield River East Branch from Windsor through Chesterfield.

Pheasant were stocked 3 days per week throughout the season. The Western District distributes 4,000 birds, released on nine WMAs: Stafford Hill (Cheshire), Eugene Moran (Windsor), George Darey Housatonic Valley (Lenox), Hop Brook (Lee), Knightville (Huntington), Hinsdale Flats (Hinsdale), Three Mile Pond (Sheffield), Flat Brook (West Stockbridge), and Peru (Peru) and 13 covers across the towns of Ashfield, Lee, Lenox, Williamstown, Hawley, Great Barrington and Pittsfield. Pheasant chicks were provided to the Lee and Ashfield sportsmen's clubs in early FY18.

The Western District hosted two sites for paraplegic sportsmen to participate during the designated three-day hunt. District staff attended all hours of the hunt and, with the help of volunteers, ensured safe and successful hunting.

Outreach and Education
District field staff interacts with the public on a daily basis, providing information and sharing enthusiasm for outdoor activities. In addition, Western District staff also participated in more formal events focused on educating the public about the agency and the environment, including the Springfield Sportsmen's Show.
The District Supervisor attended monthly meetings and provided updates to the Berkshire County League of Sportsmen and to the Hampshire County League of Sportsmen's Clubs when the meetings occurred in the Western District. He also presented information to the Deerfield River Trout Unlimited chapter.

The District Stewardship Biologist hosted a booth at the Berkshire Natural History Conference and attended the Massachusetts Land Trust Conference.

The Fisheries Biologist worked with Wahconah Regional High School on numerous occasions demonstrating trout stocking and fisheries survey techniques. She also presented to the Taconic Chapter of Trout Unlimited, and participated in the Westfield River Watershed Symposium and meetings of the Westfield River Wild and Scenic Committee.

The Wildlife Biologist gave presentations at the Conwell Elementary School and the Student Conservation Association in Hawley.

District Staff instructed archery programs in cooperation with Berkshire Natural Resources Council 50th anniversary event and at the Chesterfield-Goshen afterschool enrichment program.

Technical Assistance
The District Clerk fielded hundreds of calls requesting technical assistance. District personnel responded to these inquiries with professionalism and expertise. The Clerk also addressed the needs of walk-in visitors and issued permits and licenses to hundreds of sportsmen. In addition to advising members of the public, District personnel were often called upon to provide technical assistance to other agencies or user groups.

The Western District responded to numerous wildlife situations in FY18. We picked up multiple hawks and owls over the course of the year. Most of these birds were young, injured, sick or otherwise unable to fly. Typically they were transported to a raptor rehabilitator. We transported 3 young fawns for rehabilitation that were orphaned or picked up by overzealous citizens. Other wildlife calls included a rattlesnake, an injured coyote, bats, and bald eagles. Many of the towns in the western district have animal control officers that work on a part time basis and are often unavailable for response. As a result, District Staff help fill the gap providing assistance with wildlife issues.

Black bear management continued to be a major activity for District staff during the spring and summer months. Calls requesting assistance, information, or simply reporting activities were an almost daily occurrence. District personnel responded with a tiered approach ranging from over the phone advice to site visits and active response.

Large Animal Response Team (LART) cases in FY18 included numerous bear calls in downtown areas, all of which were resolved without immobilization. A yearling bear injured in a car strike was picked up by a citizen and transported to a rehabilitator. The animal had a fractured skull and was euthanized by District staff. The only immobilization case in FY18 involved a deer trapped in the flood chutes in North Adams which was safely removed. A small yearling bear weighing only 9lbs was captured and transported Tufts, where it was rehabbed and released.

In recent years we have seen and increased frequency of bears entering homes. The District typically responds to these cases with site visits.

District Personnel

Northeast Wildlife District
Patricia Huckery, District Supervisor
Jesse Caney, Wildlife Technician
Travis Drudi, Wildlife Technician
Anne Gagnon, Land Agent (DFG)
Joshua Gahagan, Wildlife Technician
Tim Mathews, Wildlife Technician
Sue Ostertag, Clerk
John Sheedy, Fisheries Biologist

Southeast Wildlife District
Jason E. Zimmer, District Supervisor
Aaron Best, Wildlife Technician
Jeff Breton, Wildlife Technician
Daniel Fortier, Wildlife Technician
John Garofoli, Wildlife Technician
Steve Hurley, Fisheries Biologist
Joan Pierce, Land Agent (DFG)
Debra Silva, Clerk
Steve Wright, Wildlife Biologist

Central Wildlife District
Todd Olanyk, District Supervisor
John Bonafini, Wildlife Technician
Mark Brideau, Fisheries Biologist
Scott Kemp, Stewardship Biologist
Ethan LaPlante, Wildlife Technician
Mike Morelly, Wildlife Biologist
Debra Manty, Clerk
Jessi Manty, Wildlife Technician
James McCarthy, Land Agent (DFG)
Ian Sypek, Wildlife Technician
Bruce Walker, Wildlife Technician

Connecticut Valley Wildlife District
Ralph Taylor, District Supervisor
Anne-Marie Bartus, Clerk (partial year)
Barbara Bourque, Clerk (partial year)
Christopher Connors, Wildlife Technician
David Fuller, Wildlife Biologist
Brian Keleher, Fisheries Biologist
Alex Krofta, Stewardship Biologist
Christina Petersen, Land Agent (DFG)
Kevin Pelosky, Wildlife Technician
Shasta Slade, Wildlife Technician
Walter Tynan, Wildlife Technician

Western Wildlife District
Andrew Madden, District Supervisor
Ray Bressette, Wildlife Technician
Nathan Buckhout, Wildlife Biologist
Tammy Ciesla, Wildlife Technician
Nancy Dewkett, Wildlife Technician
Debra Lipa, Clerk
Derek McDermott, Wildlife Technician
Peter Milanesi, Land Agent (DFG)
Jacob Morris-Siegel, Land Stewardship Biologist
Leanda Fontaine Gagnon, Fisheries Biologist

Wildlife Lands
Acquisition and Realty Stewardship

Craig A. MacDonnell
Chief of Wildlife Lands

Realty Section Updates
The Realty Section underwent some staff changes this fiscal year with the hiring of Christine Chisholm as the new Fee Stewardship Coordinator and the retiring of the Chief of Wildlife Lands Craig MacDonnell. The Fee Stewardship Coordinator is a new position within the Division. Chris will be working with District Staff and Headquarters to coordinate a variety of stewardship issues as they relate to the land the DFG and MassWildlife own in fee.

A new Chief, Elizabeth Wroblicka was hired and will begin working officially for the agency in July, 2018. Elizabeth's responsibilities will include working with DFG staff, the Fisheries and Wildlife Board, land trust partners, and EEA on land and conservation restriction acquisitions. She will be working closely with the senior management, legal, and each District to continue MassWildlife's strong stewardship ethic established by her predecessors.

Land and Conservation Restriction Acquisitions in FY 2018

The Department of Fish and Game (DFG) and the Division of Fisheries and Wildlife(MassWildlife) work together to protect the Commonwealth's most important fish and wildlife habitat and to expand the public's access to land and inland waters for hunting, trapping, and fishing. To accomplish this dual mission, DFG/MassWildlife's Land Protection Program uses funding from the Environmental Bond and the Wildlands Stamp Fund to purchase land and conservation restrictions from willing landowners who seek to conserve their property. Some landowners donate their land or a conservation restriction to DFG/MassWildlife, which may result in an income tax deduction for the landowner.

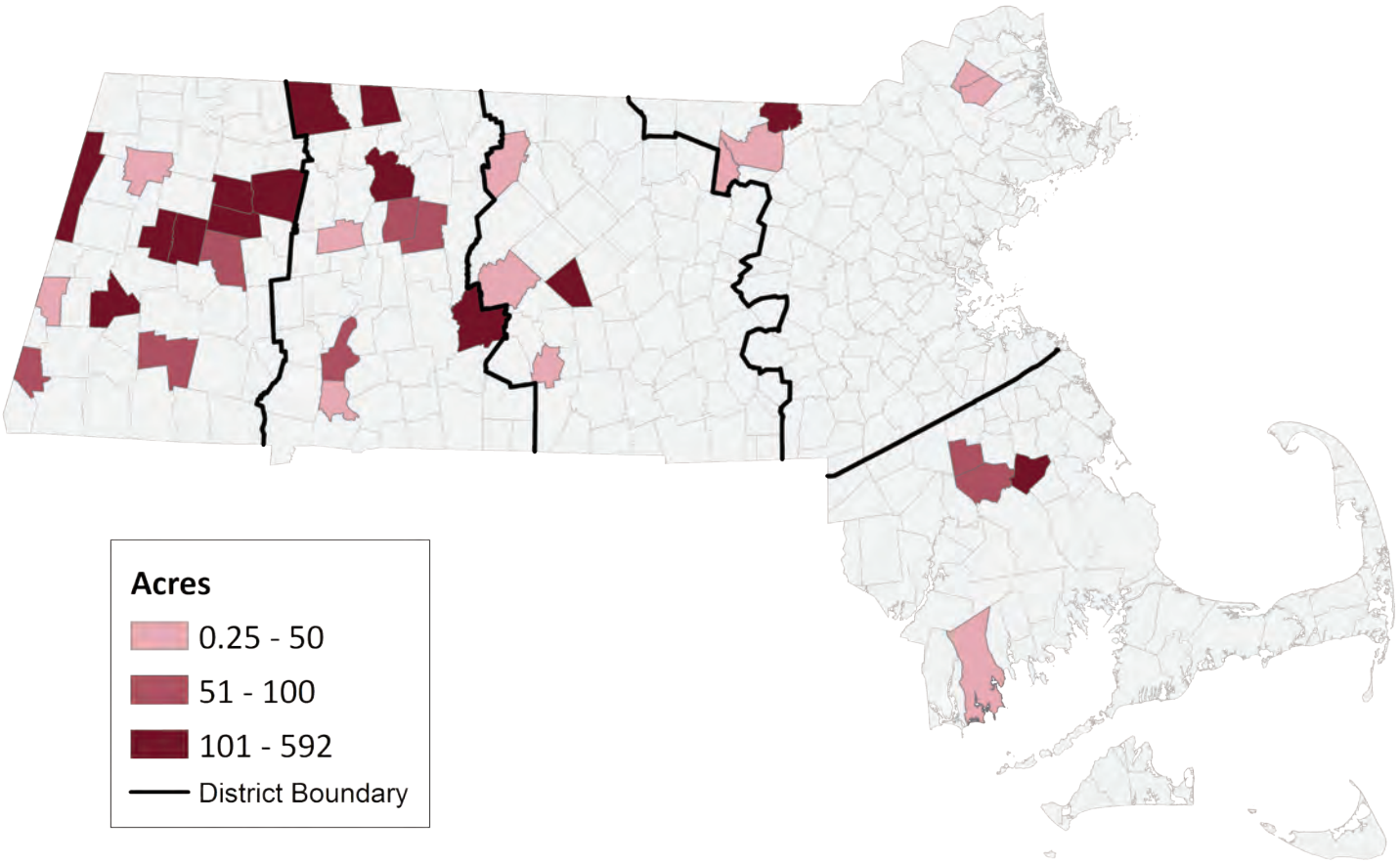
Fiscal Year 2018 was a successful year for protecting land across the state that resulted in myriad public benefits. Land agents in each of the five districts completed a total of 47 projects covering 2,981 acres, of which 436 acres were acquired by gift. The total acquisition cost of $4.6 million improves Massachusetts' climate change resiliency by protecting forests that absorb carbon dioxide, keeping land open along rivers, streams, and wetlands that work to absorb flood waters in extreme weather events, and by connecting large swaths of wildlife habitat to allow plants and animals the ability to adapt to changing weather conditions.

Fifteen projects were completed in the Connecticut Valley District protecting 863 acres at a cost of $1,092,220. One unique acquisition is an Eversource property in Montague. The 150-acre parcel contains several different habitats, including an oxbow of the Millers River, a rich mesic forest, an old gravel pit that now contains early successional forest, a three-acre hay field, steep ledges, a hemlock forest, a large vernal pool and an upland oak forest.

In the Southeast District, seven projects were completed covering 330 acres for a total cost of $354,600. The acquisitions include a gift of a conservation restriction on 165 acres in Halifax. Acreage was added to: the Hockomock Swamp WMA (West Bridgewater) , the SE Mass BioReserve (Dartmouth), to the Upper Taunton River WMA (Bridgewater) and to Burrage Pond WMA (Halifax).

In particular, the acquisition from the Town of Halifax was of a 17 acre parcel that has strategic importance due to its location in relation to other desirable parcels we hope to add to the WMA.
Two projects in Bridgewater added floodplain forest to the existing protected open space corridor along the upper Taunton River.

In the Northeast District, eight land acquisition proj-



	WESTERN	VALLEY	CENTRAL	NORTHEAST	SOUTHEAST	TOTAL
WMA	46,673.3	19,649.2	39,266.8	17,347.4	43,937.2	166,874.0
WCE	17,371.6	8,827.4	9,364.3	2,099.7	11,378.5	49,041.5
Access	35.8	518.3	685.0	234.7	54.2	1,527.9
Sanctuary	427.5		367.9	552.5	73.0	1,420.9
WCR	69.4	2.4	856.9	127.0	37.9	1,093.6
Installation	2.4	579.2		107.8	108.4	797.8
Other				372.0	11.0	383.0
TOTAL	64,580.0	29,576.6	50,540.9	20,841.1	55,600.2	221,138.7

WMA (Wildlife Management Area) – Land owned outright by DFG/MassWildlife. Open to the public for hunting, fishing, trapping and other passive recreation. Subject to Wildlife Management Area Regulations

WCE (Wildlife Conservation Easement) – DFG/MassWildlife owns development and recreation rights. Open to the public for hunting, fishing, trapping and other passive recreation.

Access Areas – Property providing public recreation access to water bodies or adjacent conservation lands owned by a third party. (Does not include Office of Fishing and Boating Access boat launches, ramps or fishing piers)

Wildlife Sanctuary – Wildlife properties donated to MassWildlife and governed by statute and regulation, fishing, hunting, and trapping are prohibited; other public recreation access is permitted.

WCR (Wildlife Conservation Restriction) – DFG or MassWildlife owns development rights, but public access is not allowed. These lands buffer wildlife habitat by preventing unwanted development.

ects were completed this fiscal year conserving 258 acres of land at a cost of $835,250. Highlights included two adjacent projects in the Town of Dunstable totaling 172 acres near the Groton border, part of the relatively new Unkety Brook WMA. These acquisitions link two previously acquired blocks of land to the north and south and provides access on Hall Street in Dunstable. A third project in Dunstable added a 20-acre piece along the Nashua River, protecting 1,500 feet along both banks of Unkety Brook (a cold-water fishery resource) and 3,000 feet of frontage along the Nashua River. Adding to our existing holdings, this will provide 2.5 miles of contiguous river frontage along the Nashua River.

The Western District completed 14 land acquisition projects that protected approximately 1320 acres of land and added to nine different Wildlife Management Area (WMA)s. The biggest land project was completed with the help of an EEA Landscape Partnership Grant (LPG). This LPG funding helped MassWildlife to acquire 466 acres in the Towns of Cummington, Plainfield and Ashfield. These 466 acres, which will become a part of the Swift River WMA, contains 4474 feet of frontage along the North Branch of Swift River. In working on this LPG project with our partner, Franklin Land Trust, MassWildlife also obtained a conservation restriction over 126 acres of land with 5071 feet of frontage along Meadow Brook. Both the Swift River and Meadow Brook are tributaries to the East Branch of the Westfield River and they are both excellent cold water streams. Another standout Western District project was the protection of 103 acres in the Town of Lee. These 103 acres will be added to the Hop Brook WMA. They contain over 5000 feet of frontage along the Housatonic River with a variety habitats including existing fields, abandoned fields, shrub land and floodplain forest. This acquisition also included a number of species listed in State's Wildlife Action Plan (SWAP) and/ or considered rare and endangered by Natural Heritage Program.

Central District land acquisition staff completed four projects protecting 213 acres of land at a cost of $386,080. In particular, acquisition of a portion of the Barringer property in Oakham provided MassWildlife with the opportunity to add 169 acres of high quality wildlife habitat, along with increased recreational opportunities, to the north extent of the Oakham Wildlife Management Area . This site is ranked as above average in resiliency to climate change due to the variability in topography interspersed with wetlands and open water habitats, which support numerous wildlife species, including: bobcat, black bear, moose, eastern towhee, white-tailed deer, beaver, coyote, red fox, fisher, ruffed grouse, American woodcock, turkey, gray and red squirrel, mallard, wood duck, and great blue heron. A diversity of wetlands are found on site including vernal pools, streams, open water pond influenced by beaver, graminoid marsh, small bog mats, and forested swamp.

The DFG/MassWildlife land acquisition team looks forward to another great year of conserving land for habitat biodiversity as well as hunting, trapping, and fishing. The total amount of acres conserved by DFG/MassWildlife is 221,138. To see a map of all of our protected properties visit mass.gov/dfw/wildlife-lands.

Stewardship Activities

MassWildlife is committed to stewarding the land and CRs that it owns for the benefit of the public. As part of fulfilling its stewardship obligations, MassWildlife has created Baseline Documentation Reports for almost all of its 200 CRs, strives to monitor all of its CRs annually, and is in the process of marking the boundaries of all of its fee lands. District staff with the assistance of Realty Section staff address access issues with signage to educate users, and in some cases gates and boulders to control access problems.

Conservation Restriction (CR)Stewardship

Stewardship Staff including CR Stewardship Coordinator Liz Newlands, and District Stewardship Biologists Aaron Best, Jenn Jones, Scott Kemp, Alex Krofta, and Jacob Morris-Siegel, and other District staff completed annual monitoring visits on 102 CR properties for a total of over 221.75 hours in the field. During these annual monitoring visits staff walked portions of CR boundaries and the interior, checking for compliance with the terms and conditions of the CR and noting inconsistent uses (if any). Overall CR lands are in good condition. Issues noted include long-standing problems that will likely continue to persist: ATV and dirt bike use on certain properties, and the presence of alien invasive plants. Field staff also noted several properties that required additional boundary signage to clarify the public's right to access the land, or to remain off of private abutting lands. Staff installed a gate

at a CR in the town of Hanson to discourage ATV use.

A total of 49 visits are categorized as "comprehensive". This is when key natural resource values of protected CR lands, such as vernal pools, cattail swamps supporting marsh birds, or interior forests, are visited to provide landowners with assistance in managing the property for wildlife and wildlife habitat. Landowners are invited to attend to discuss questions about their CR, review issues landowners may have, review processes dictated by the CR, and where appropriate, how the agency can assist in public access and/or management of the property.

Staff also worked collaboratively to review forest management plans for six CR landowners, and responded to all landowner requests for other allowable uses such as trails development and agricultural use. In each of these instances, staff worked with the landowner to achieve their land management goals and objectives while protecting the agency's interest in wildlife and wildlife habitat.

Surveys

MassWildlife hired four private survey contractors to help resolve a number of challenging boundary questions that have arisen in the Districts. Land Agents, Stewardship Biologists, Realty staff and District Managers worked closely with these contractors, who prepared survey plans and set boundary markers at 4 different properties spread among the Districts.

Boundaries

MassWildlife engaged the services of six experienced contractors in FY18 for the purpose of confirming over 102 miles of property boundaries at various WMAs and WCEs in each of the five Wildlife Districts. All of the Districts reported excellent progress on this much-needed project, with some variation in accomplishment depending on location and parcel configuration. Boundaries on larger parcels with less intricate boundaries typically were easier to confirm. District staff, with assistance from Realty staff in Field Headquarters, provided our contractors with maps and deeds together with basic orientation. Our contractors performed a diverse set of tasks depending on district preference, including researching deeds, locating boundaries in the field, creating GPS track-logs, blazing and painting trees, and hanging MassWildlife signage.

Realty Staff

Craig A. MacDonnell, Chief of Wildlife Lands
Philip Truesdell, Regional Planner IV (partial year)
Elizabeth Newlands, CR Stewardship Coordinator
Christine Chisholm, Land Stewardship Coordinator

Photo by Bill Byrne/MassWildlife

Row Labels	Sum of Report Acres
Central District	**49467.275**
Access	**683.55**
Bare Hill Pond Access	1.45
Blackstone / West River Access	28
Cusky Pond Access	23
Five Mile River Access	178.52
Glen Echo Lake Access	1
Leadmine Pond Access	0.05
Moose Brook Access	20.13
Mossy Pond Access	17
Natty Brook Access	95.17
North Pond Access	0.18
Quag Pond Bog Access	31
Quinapoxet River Access	32
Quinsigamond Marsh Access	59
Quinsigamond River Access	18.6
Sevenmile River Access	77
South Meadow Pond Access	0.25
Sputtermill Pond Access	58.5
Tully River Access	1
Ware River Access - Barre	40
Webster Lake Access	1.7
Sanctuary	**367.91**
Mount Watatic Sanctuary	228
Susan B. Minns Sanctuary	139.91
WCE	**8725.5**
Benjamin Hill WCE	87.5
Breakneck Brook WCE	526
Burnshirt River WCE	100
Carter Pond WCE	300.5
Fish Brook WCE	75
Fitchburg Watershed WCE	1875
Hitchcock Mountain WCE	110.5
Lawrence Brook WCE	462.6
Leadmine Mountain WCE	826.37
Long Pond WCE	8.85
McKinstry Brook WCE	31
Millers River WCE	194.22
Moose Brook WCE	125
Mt. Pisgah WCE	19.12
Muddy Brook WCE	575.69
Newton Reservoir WCE	622
Nineteenth Hill WCE	623.75
Potter Hill WCE	90.8
Quisset WCE	247
Savage Hill WCE	234
Secret Lake WCE	311.3
Slater Woods WCE	73.9
Stuart Pond WCE	28.7
Taft Hill WCE	394.6
Wekepeke WCE	564
Whitmanville WCE	118.1
Winimusset WCE	100
WCR	**746.41**
Breakneck Brook WCR	176
Five Mile River WCR	17.27
Hitchcock Mountain WCR	499.5
McKinstry Brook WCR	26
Raccoon Hill WCR	22
Williamsville Pond WCR	5.64
WMA	**38943.905**
Bennett WMA	281.2
Birch Hill WMA	4550.75
Bolton Flats WMA	1319.88
Breakneck Brook WMA	707
Chockalog Swamp WMA	52.5
Clinton Bluff WMA	42
Coy Hill WMA	1013.5
E. Kent Swift WMA	157
Fish Brook WMA	142.5
Four Chimneys WMA	200
High Ridge WMA	2240.87
Hitchcock Mountain WMA	268.41
Lackey Pond WMA	174.54
Lawrence Brook WMA	295.5
Leadmine WMA	826
Long Pond WMA	5.6
Martha Deering WMA	232.58
McKinstry Brook WMA	291.3
Merrill Pond WMA	1037.06
Millers River WMA	3749.76
Mine Brook WMA	1062.15

Moose Brook WMA	849.195
Moose Hill WMA	640.1
Mt. Pisgah WMA	88.8
Muddy Brook WMA	1842.68
Nineteenth Hill WMA	293.6
Oakham WMA	911.2
Phillipston WMA	3224.03
Popple Camp WMA	1459.91
Poutwater Pond WMA	391.74
Prince River WMA	748.95
Quaboag WMA	1822.53
Quacumquasit WMA	179.82
Quisset WMA	424.69
Raccoon Hill WMA	646.16
Richardson WMA	467.22
Savage Hill WMA	930.96
Scripture Hill WMA	121
Stone Bridge WMA	505.17
Sucker Brook WMA	102.6
Thayer Pond WMA	131
Ware River WMA	185.36
Wayne F. MacCallum WMA	894.58
West Hill WMA	350
Whortleberry Hill WMA	324.4
Winchendon Springs WMA	854.06
Winimusset WMA	670.17
Wolf Swamp WMA	1233.88
Row Labels	**Sum of Report Acres**
Connecticut Valley District	**30116.679**
Access	**518.31**
Connecticut River Access	94.8
Deerfield River Access	21
Lake Lorraine Access	0.26
Lake Quinsigamond Access	6.49
Lake Rohunta Access	2.49
Little Alum Pond Access	0.5
Mill River Access	14.15
Millers River Access	52.8
Packard Pond Access	0.54
Sawmill River Access	52
Tully Brook Access	154.88
Ware River Access	39

Westfield River Access	79.4
Installation	**579.22**
WCE	**8733.7**
Amythyst Brook WCE	36.9
Brushy Mountain WCE	78
Chestnut Hill WCE	175.4
Facing Rock WCE	190
Flagg Mountain WCE	345
Great Swamp WCE	0.94
Honey Pot WCE	52.74
Lake Rohunta WCE	59
Little Tully Mountain WCE	461.38
Ludlow Reservoir WCE	1750
Orange WCE	877.97
Paul C. Jones Working Forest WCE	3486
Satan's Kingdom WCE	527.5
Tully Mountain WCE	692.87
WCR	**2.39**
Wendell WCR	2.39
WMA	**20283.059**
Bachelor Brook WMA	93.7
Bennett Meadows WMA	201
Brewer Brook WMA	386.29
Brushy Mountain WMA	181.38
Catamount WMA	413
Darwin Scott WMA	27.3
East Mountain WMA	604.45
Facing Rock WMA	1366.1
Flagg Mountain WMA	223.69
Great Swamp WMA	695.75
Green River WMA (Valley District)	507.85
Herman Covey WMA	1492.98
Honey Pot WMA	178.42
Lake Warner WMA	98
Leyden WMA	759
Montague Plains WMA	1930.219
Montague WMA	2004.29
Mt. Esther WMA	328.95
Mt. Toby WMA	688.1
Mt. Tom WMA	79.9

Orange WMA	374.1
Palmer WMA	1478.43
Pauchaug Brook WMA	161.3
Poland Brook WMA	707.53
Rainbow Beach WMA	45.9
Satan's Kingdom WMA	1950.79
Shattuck Brook WMA	178.8
Southampton WMA	170.6
Southwick WMA	348.28
Sunderland Islands WMA	15
Tully Mountain WMA	704
Wales WMA	207.15
Warwick WMA	379
Wendell WMA	591.19
Westfield WMA	234.03
Whately WMA	388.59
Williamsburg WMA	88
Row Labels	**Sum of Report Acres**
Northeast District	**17693.87**
Access	**234.69**
Baddacook Pond Access	0.16
Flint Pond Access	89
Ipswich River Access	1.79
Knops Pond Access	0.6
Lake Attitash Access	6.03
Long Sought For Pond Access	1
Mascuppic Lake Access	0.25
Nashua River Access - Dunstable	15
Nashua River Access - Groton	10.1
Nashua River Access - Pepperell	11.2
Nashua River Access - Shirley	31.2
Sudbury River Access	51.86
Weymouth Back River Access	16.5
Installation	**106.42**
Other	**371.95**
Sanctuary	**552.48**
Carr Island Sanctuary	110.5
Henry Cabot Lodge Bird Sanctuary (Egg Rock)	2
J. C. Phillips Sanctuary	390.98
Milk Island Sanctuary	29
Ram Island Sanctuary (North)	20
WCE	**2126.46**
Concord River WCE	18.9
Cow Pond Brook WCE	127
Devil's Den WCE	28
Great Meadows WCE	16
Great Swamp Brook WCE	106
Groton Town Forest WCE	513
Hunting Hills WCE	84.59
Martin H. Burns WCE	113.44
Meadow Pond WCE	58
Pepperell Springs WCE	255
Squannacook River WCE	299.33
Sucker Brook WCE	12
Surrenden Farm West WCE	169.7
Throne Hill WCE	177.5
Wright Ponds WCE	148
WCR	**127**
Mill Creek WCR	59
Squannacook River WCR	68
WMA	**14174.87**
Ashby WMA	946.76
Boxborough Station WMA	124.1
Castle Neck River WMA	54.67
Crane Pond WMA	2605.21
Dunstable Brook WMA	177.35
Eagle Island WMA	5
Elbow Meadow WMA	210.33
Fessenden Hill WMA	21
Flagg Swamp WMA	54
Great Marsh North WMA	430.12
Hauk Swamp WMA	61
Hunting Hills WMA	430.02
Martin H. Burns WMA	1576.7
Mulpus Brook WMA	496.43
Nissitissit River WMA	410.56
Pantry Brook WMA	449.95
Salisbury Salt Marsh WMA	855.87
Squannacook River WMA	1643.55
Townsend Hill WMA	655.32
Trapfall Brook WMA	45.38

Unkety Brook WMA	767.56
Upper Parker River WMA	188.1
Whittier WMA	42
William Forward WMA	1923.89
Row Labels	**Sum of Report Acres**
Southeast District	**56273.34**
Access	**54.65**
Agawam Mill Pond Access	1.4
Agawam Mill Pond Access & WCE	0.5
Bakers Pond Access	1.75
Barnstable Harbor Access	2.78
Big Sandy Pond Access	0.2
Childs River Access	0.25
Cook Pond Access	3
Dogfish Bar Beach Access	2.4
Great Herring Pond Access	1.06
Johns Pond Access	0.52
Mashpee-Wakeby Pond Access	25
Nemasket River Access	0.46
Popponesset Beach Access	1.5
Robbins Pond Access	1
Scorton Creek Access	5.48
Shubael Pond Access	0.35
Snipatuit Pond Access	0.5
Spectacle Pond Access	0.5
Tispaquin Pond Access	6
Installation	**114.36**
Other	**5.94**
Sanctuary	**78.5**
Billingsgate Island Sanctuary	12
Penikese Island Sanctuary	60
Ram Island Sanctuary (South)	2
Tarpaulin Cove Sanctuary	4.5
WCE	**11535.27**
Acushnet River WCE	30.2
Agawam River WCE	3.98
Angeline Brook WCE	100.7
Assawompsett Pond Complex WCE	3065
Bettys Neck WCE	329.22
Billington Sea WCE	69.74
Brandt Island Cove WCE	109.52
Bread and Cheese Brook WCE	5.52
Camp Cachelot WCE	789
Copicut WCE	486.22
Halfway Pond WCE	28
Lake Nippenicket WCE	8.35
Maple Springs WCE	257.88
Pickerel Cove WCE	78.3
Pilgrim Springs WCE	17.05
Plymouth Pine Hill WCE	240.7
Plymouth Town Forest WCE	296
Poor Meadow Brook WCE	101
Quashnet River WCE	14.1
Santuit Pond WCE	293
Sippican Woods WCE	390.14
South Triangle Pond WCE	47.5
Stump Brook Reservoir WCE	174
Taunton River WCE	290.07
Watuppa Reservation WCE	4300
Weweantic River WCE	10.08
WCR	**37.9**
Plymouth Grassy Pond WCR	33.9
Taunton River WCR	4
WMA	**44446.72**
Atwood Reservoir WMA	511.07
Bearse Pond WMA	5.8
Black Brook WMA	411.32
Blueberry Pond WMA	1.5
Brayton Point WMA	2.2
Burrage Pond WMA	1835.08
Camp Edwards WMA	15013.16
Canoe River WMA	116.6
Chase Garden Creek WMA	56.4
Clapps Pond WMA	68.35
Cooks Pond WMA	69.18
Copicut WMA	3992.56
Dartmoor Farm WMA	473
Dennis Grassy Pond WMA	7.24
Eastham Salt Marsh WMA	7.44
English Salt Marsh WMA	288.5
Erwin S. Wilder WMA	540.95

Fisk Forestdale WMA	235
Fox Island WMA	71.1
Frances A. Crane WMA	2170.31
Gosnold WMA	3.45
Halfway Pond WMA	122.64
Hartley Reservoir WMA	70
Haskell Swamp WMA	3111.22
Head Of The Plains WMA	2
Hockomock Swamp WMA	4552.54
Hog Ponds WMA	24.5
Hyannis Ponds WMA	365
Katama Plains WMA	18.57
Maple Springs WMA	774.57
Marconi WMA	1211
Mashpee Pine Barrens WMA	198.35
Mashpee River WMA	55.8
Mattapoisett River WMA	163
Meetinghouse Swamp WMA	123
Miacomet Heath WMA	3.83
Mill Brook Bogs WMA	584.52
Muddy Pond WMA	72
Noquochoke WMA	204.5
North Attleborough WMA	36.46
Old Sandwich Game Farm WMA	93.13
Olivers Pond WMA	12
Peterson Swamp WMA	250
Pickerel Cove WMA	15.9
Plymouth Grassy Pond WMA	25.5
Poor Meadow Brook WMA	161.61
Provincetown Corridor WMA	122
Purchade Brook WMA	106
Quashnet River WMA	51.54
Quashnet Woods State Reservation & WMA	360
Red Brook WMA	683.2
Rocky Gutter WMA	3142.89
Sandwich Hollows WMA	224.2
SE Pine Barrens WMA	436.84
Sly Pond WMA	192
South Shore Marshes WMA	22.4
Taunton River WMA	550.42
Triangle Pond WMA	92.16
Wasque Point WMA	99.5
West Meadows WMA	231.72
Row Labels	**Sum of Report Acres**
Western District	**64105.297**
Access	**35.82**
Deerfield River Access - Charlemont	0.62
Hoosic River Access	5.9
Housatonic River Access	17
Konkapot River Access	8.8
Westfield River Access - Chester	3.5
Installation	**2.35**
Sanctuary	**427.5**
E. Howe Forbush Sanctuary	365.5
Grace A. Robson Sanctuary	62
WCE	**15488.85**
Abbott Brook WCE	1782
Alford Spring WCE	889.82
Allen Mountain WCE	208
Boulders WCE	642.53
Cold Brook WCE	405
Cole Meadow WCE	101
Flag Rock WCE	41.38
Hawks Brook WCE	23.19
Housatonic River East Branch WCE	114.83
Jug End Fen WCE	81.57
Jug End WCE	262.48
Knightville WCE	676
Meadow Brook WCE	126.04
Mt. Darby WCE	319.29
Mt. Plantain WCE	1337.44
North Egremont WCE	21.5
North River West Branch WCE	96.2
Rockhouse Mountain WCE	78
Scout Pond WCE	175.9
Shales Brook WCE	5.6
Silver Brook WCE	162
Stage Brook WCE	581

Steadman Pond WCE	1170.95
Thorpe Brook WCE	266.2
Umpachene River WCE	239
Upper Westfield River WCE	12.5
Westfield Watershed WCE	2300
Widow White's Peak WCE	85
Windsor Brook WCE	3284.43
WCR	**69.4**
Windsor Brook WCR	69.4
WMA	**48081.377**
Abbott Brook WMA	18
Agawam Lake WMA	785.75
Ashfield Hawley WMA	284
Barton's Ledge WMA	88.6
Bullock Ledge WMA	15.5
Chalet WMA	7614.48
Cummington WMA	288.97
Day Mountain WMA	382.45
Dolomite Ledges WMA	319.85
Eugene D. Moran WMA	1870.427
Fairfield Brook WMA	164.9
Farmington River WMA	1901.1
Fisk Meadows WMA	638.17
Flat Brook WMA	273.15
Fox Den WMA	5062.46
George L. Darey Housatonic Valley WMA	812.93
Green River WMA (Western District)	489.12
Hawks Brook WMA	509.83
Hinsdale Flats WMA	2025.51
Hiram H. Fox WMA	3754.19
Hop Brook WMA	527.53
Housatonic River East Branch WMA	27.5
Hubbard Brook WMA	195.93
John J. Kelly WMA	267
Jug End Fen WMA	112.54
Jug End State Reservation and WMA	1169.8
Jug End WMA	20
Kampoosa Fen WMA	72
Knightville Dam WMA	0
Lilly Pond WMA	350.7
Long Mountain WMA	958.84
Maple Hill WMA	595.55
Maxwell Brook WMA	36.4
Misery Mountain WMA	1336.04
North Egremont WMA	25.96
Oak Hill WMA	712.3
Peru WMA	5013.47
Powell Brook WMA	404.58
Ram Hill WMA	468.83
Richmond Fen WMA	22.9
Savoy WMA	1883.34
Shales Brook WMA	234
Shaw Brook WMA	153.33
Stafford Hill WMA	904.6
Stage Brook WMA	148.3
Swift River WMA	757.73
Tekoa Mountain WMA	1383.3
Three Mile Pond WMA	1141.82
Tower Brook WMA	298.61
Tracy Pond WMA	225.07
Upper Westfield River WMA	310.32
Walnut Hill WMA	988.7
Williams River WMA	35
Grand Total	**221138.7**

Federal Aid Program Administration

Mike Sawyers
Federal Aid Coordinator

Overview
The Federal Aid Coordinator, acting through the Deputy Director, implements MassWildlife's Federal Aid Program, including oversight of documentation, reporting, compliance with acts and regulations, and other requirements for the administration of federal grants, as well as serving as liaison between the grantee and Federal agencies – including the Region 5 office of the U.S. Fish and Wildlife Service (USFWS) grant administrator for the U.S. Department of the Interior and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture.

Federal Aid in Wildlife Restoration (Pittman-Robertson)
MassWildlife's apportionment of Federal Aid in Wildlife Restoration funds, $7,986,372, was an increase from last year's apportionment. These funds are available for wildlife restoration projects and hunter education. The following projects were reimbursed with these funds: hunter education, wildlife population trends and harvest surveys, waterfowl research and management, wildlife habitat management, land acquisition, and program coordination.

Federal Aid in Sport Fish Restoration (Dingell-Johnson and Wallop-Breaux)

The State's Federal Aid in Sport Fish Restoration Act apportionment of $3,519,175 represents an increase over last year's apportionment. These funds were divided as follows: The Department of Fish and Game's Office of Fishing and Boating Access (OFBA), which is responsible for constructing and maintaining motorboat access facilities, received $527,876 (15%); and the balance of $2,991,299 was equally divided between the Division of Marine Fisheries and MassWildlife ($1,495,649 each).

One project was obligated with the OFBA and MassWildlife shares of the FY 18 Dingell-Johnson and Wallop-Breaux funds. The OFBA, in cooperation with MassWildlife, had ten boat accommodation grants active in FY 18. MassWildlife activities reimbursed under the Sport Fish Restoration Program include aquatic resources education, program coordination, hatchery operations, hatchery maintenance, fish distribution, and anadromous fish coordination and technical assistance.

State Wildlife Grant Program (SWG)
MassWildlife's State Wildlife Grant apportionment of $742,540 was an increase from the previous year. The SWG funds were applied to six projects. Activities reimbursed under those projects include fish community research, anadromous fish restoration, biodiversity impact review, biodiversity inventory and research, biodiversity conservation mapping and planning, habitat evaluation, regional conservation needs, program coordination, and in the development and implementation of the Massachusetts State Wildlife Action Plan. Through a regional effort, New Hampshire, Connecticut, New York, Maine, and Massachusetts were awarded a total of $3,000,000 through the FY 10, FY 11, FY 13, and FY 14 national State Wildlife Grant competitive programs to implement the Rangewide New England Cottontail (NEC) Initiative. Massachusetts' share of the funds ($723,475) will be used to restore NEC habitat in Massachusetts. Implementation of the NEC Initiative will continue through FY 19.

MassWildlife was also awarded $277,719 through the FY 13 national State Wildlife Grant competitive program to fund the Conservation of Snake Species Threatened by an Emerging Fungal Skin Disease. MassWildlife partnered with New Hampshire, Connecticut, Vermont, New Jersey, Tennessee, Minnesota, Wisconsin, and Illinois to address this nationally important conservation issue. This cooperative project was completed in FY 18. MassWildlife served as the lead state and was awarded $269,955 through the FY 14 national State Wildlife Grant Competitive program to fund Conservation Planning and Implementation for the Wood Turtle. MassWildlife is partnering with Maine, New Hampshire, Connecticut, Pennsylvania, New Jersey, Maryland, and Virginia. This cooperative project will continue through FY 19.

MassWildlife was awarded $20,000 through the FY 15 national State Wildlife Grant competitive program to fund the Multistate Recovery Actions for the Bog Turtle and Associated Headwater Wetland Species of Greatest Conservation Need. MassWildlife is partnering with Pennsylvania, Maryland, New Jersey, and Connecticut. This cooperative project will continue through FY 19.
MassWildlife served as the lead state and was awarded $402,545 through the FY 16 national State Wildlife Grant Competitive program to fund the Brook Floater Rangewide Conservation and Restoration Initiative. MassWildlife is partnering with the states of Maine, New Hampshire, and Virginia. This cooperative project will continue through FY 20.

Also in FY 16, MassWildlife was awarded $101,000 through the national State Wildlife Grant competitive program to fund the Northeast Blanding's Turtle Initiative. MassWildlife is partnering with the states of New Hampshire, Maine, and Pennsylvania. This cooperative project expands upon a previous grant that was completed in FY 16. Implementation of the Blanding's Turtle grant will continue through FY 20.

MassWildlife was awarded $40,000.00 through the FY 17 national State Wildlife Grant competitive program to fund the Conservation and Management of the Spotted Turtle and Seasonal Wetland Habitats in the Eastern U.S. MassWildlife is partnering with the states of Virginia, Connecticut, Maine, New Hampshire, Pennsylvania, and Georgia, as well as the District of Columbia. This cooperative project will continue through FY 21.

North American Wetlands Conservation Act (NAWCA)
During FY 15, the MassWildlife was awarded $720,002 under the North American Wetlands Conservation Act for a proposal to fund wetland protection, restoration, and enhancement in the Great Marsh in Essex County. MassWildlife has established partnerships with other state agencies, municipalities, conservation organizations, and private individuals to accomplish the goals of the project. Project implementation will continue through FY 19.

Monarch Butterfly Conservation Fund

During FY 16, MassWildlife was awarded $21,500 under the Monarch Butterfly Conservation Fund for a proposal to increase habitat for pollinating insects by seeding highway median and roadside areas with a mix of milkweed and other native plants for pollinators by partnering with other state agencies, including the Department of Transportation and Department of Conservation and Recreation. To increase public awareness about pollinators, MassWildlife also created a pollinator demonstration plot at the Westborough Field Headquarters. This project was completed in FY 18.

Regional Conservation Partnership Program
During FY 17, MassWildlife was awarded $286,520 in Natural Resources Conservation Service Funds through a cooperative agreement with the Wildlife Management Institute to provide technical assistance to private landowners interested in conducting habitat management on their property. Implementation of this cooperative agreement will continue through FY 20.

Audits
The office of the State Auditor conducts a state audit of the MassWildlife Federal Aid Program once every two years and the U.S. Department of Interior, Office of Inspector General, conducts a federal audit of the program once every 5 years. No audits were active in FY 18.

Other Matters
Additional Federal Aid Coordinator's duties included responding to requests for information, public inquiries, MassWildlife inventory management, overview of projects performance and financial reporting, project assistance (both field and office), field visits, and serving as the liaison between all Federal Aid personnel and the MassWildlife.

Federal Aid Program Personnel
Kris McCarthy, Associate Director of Administration & Finance
Mike Sawyers, Federal Aid Coordinator
Lori Cookman, Fiscal Program Coordinator
Debra Chamberlain, Assistant to the Federal Aid Coordinator
Debbie McGrath, Federal Aid Bookkeeper

Staff and Agency Recognition

FY 2018 MassWildlife Staff/Agency Recognition

In November 2017, the Department of Fish and Game was recognized for its leadership in promoting clean energy and environmental initiatives with the Commonwealth's 11th annual Leading by Example Awards. The award recognized DFG's energy saving projects at several facilities including MassWildlife's McLaughlin Hatchery in Belchertown and the Division of Marine Fisheries' Shellfish Purification Plant in Newburyport. Also acknowledged were its partnership efforts with MassDOT, DCR, Department of Corrections, Department of Mental Health and Mass Audubon to create pollinator-friendly habitats, land conservation and management programs and for its Westborough office building with an innovative zero net energy design.

In March, Carolyn Mostello, MassWildlife Coastal Waterbird Biologist received MassAudubon's first Hemenway + Hall Wildlife Conservation Award. Her work focuses on restoring populations of coastal waterbird species, including American oystercatchers, common eiders, common terns, and endangered roseate terns. Through Carolyn's dedication—and that of her project partners—the roseate tern population within Buzzards Bay has increased by 37% over the past eight years. Harriet Hemenway and Minna Hall founded Mass Audubon in 1896 as part of their campaign to stop the commercial killing of birds for feathers in fashionable hats of the time. This new award bearing their names recognizes an individual for success in the preservation, enhancement, and restoration of a New England species and/or their habitat, as well as an enthusiasm for sharing information about their efforts and a commitment to inspiring future generations of conservation professionals.

In spring 2018 – MassWildlife Retirees Bill Davis Central District Manager and Ralph Taylor Connecticut Valley District Manager received public service awards from the Massachusetts Sportsmen's Council acknowledging their years of service with MassWildlife. Bill Davis was also recognized by the Worcester County League of Sportmen's Clubs at their annual banquet for his dedication and service to the Commonwealth's wildlife and the sporting community.

In June of 2018, Susan Langlois, MassWildlife Hunter Education Administrator was awarded the Dr. Edward Kozicky Award from International Hunter Education Association (IHEA) for outstanding assistance to the IHEA-USA president. This award honors an individual or organization that assists the President of the IHEA-USA in a manner that exceeds a general effort and above/beyond the call of duty. In the past few years she has worked with IHEA-USA on the following:

NRA Online Hunter Education Course development, reviewed research proposals, reviewed and updated trapper education standards, and served on the basic hunter education standards development team.

Carolyn Mostello, MassWildlife Coastal Waterbird Biologist

Personnel Report

Johanna Zabriskie
EEA Deputy Human Resources Director / Dept. of Fish and Game

New Hires - Employee			
Name	**Title**	**Action**	**Date of Action**
Caney, Jesse	Wildlife Technician II	New Hire	May 29, 2018
Cheeseman, Melany	Office Support Specialist II	New Hire	November 26, 2017
Cruz, Megan	Wildlife Technician III	New Hire	May 29, 2018
Gendreau, Rebecca	Office Support Specialist II	New Hire	September 10, 2017
Krofta, Alex	Game Biologist I	New Hire	August 6, 2017
Pratt, Cynthia	Office Support Specialist I	New Hire	July 9, 2017
Simoes, Jody	Game Biologist IV	New Hire	February 20, 2018
Weise, Amanda	Conservation Biologist II	New Hire	July 23, 2017
Zimmerer, Rebekah	Conservation Biologist III	New Hire	April 1, 2018
Seasonals & Interns Hires			
Name	**Title**	**Action**	**Date of Action**
Asta-Ferrero, Joseph	Fisheries Technicians	Contract Seasonal	April 1, 2018
Averka, Jacob	Laborer I – Angler Education	Seasonal Hire	May 29, 2018
Boulia, Joseph	Fisheries Technician	Contract Seasonal	April 1, 2018
Burt, Adam	Fisheries Technician	Contract Seasonal	April 1, 2018
Callahan, Michael A.	Tern Colony – Predator Control	Contract Seasonal	April 29, 2018
Clark, Michael J	Wildlife Technician I - Hatchery	Seasonal Hire	June 10, 2018
Dunin-Wilczynski, Elizabeth	Fisheries Technician	Contract Seasonal	April 15, 2018
Grasso, Kyle D.	Fisheries Technician	Contract Seasonal	May 13, 2018
Jillson, Leo Richard	Seasonal Tern Colony Intern	Contract Seasonal	May 7, 2018
Jordan, Fredrick Dallas	Tern Colony – Site Manager	Contract Seasonal	April 29, 2018
Kendall, Philip	Laborer I – Angler Education	Seasonal Hire	May 29, 2018
Liljesthrom, Marcela	Tern Colony – Site Manager	Contract Seasonal	April 29, 2018
Pszybysz, Tara	Fisheries Technician	Contract Seasonal	April 15, 2018
Rawinski, Peter T.	Fisheries Technicians	Contract Seasonal	May 13, 2018
Titherington, Kaiti	Wildlife Technician	Contract Seasonal	October 22, 2017
Toupouzis, Deborah	Fisheries Technician	Contract Seasonal	April 15, 2018
Treadway, Ashlin	Wildlife Technician	Contract Seasonal	March 18, 2018
Vhay, Megan	Wildlife Technician	Contract Seasonal	March 18, 2018

Terminations – Employee			
Name	**Title**	**Action**	**Date**
Buckley, John L. (Jack)	Director of Fisheries and Wildlife	Retired	May 1, 2018
Byrne Jr., William C	Game Biologist III	Deceased	May 13, 2018
Davis, William	Central District Manager – Environmental Analyst V	Retired	May 1, 2018
Ford, Jennifer	Clerk III	Resigned	June 5, 2018
Gabriel, David G.	Graphic Artist	Retired	August 12, 2017
Gendreau, Rebecca Ann	Office Support Specialist II	Resigned	October 7, 2017
MacDonnell, Craig A.	Environmental Analyst V	Retired	May 1, 2018
Powers, Brent	Conservation Biologist III	Resigned	August 19, 2017
Stover, Matthew	Game Biologist I	Resigned	July 29, 2017
Taylor, Ralph	Valley District Manager – Environmental Analyst V	Retired	June 9, 2018
Townsend, Susan	Wildlife Technician III	Retired	December 1, 2017
Truesdell, Philip	Regional Planner IV	Retired	October 18, 2017
Weise, Amanda	Conservation Biologist III	Probationary Period	November 11, 2017
Zukauskas, Karl B.	Wildlife Technician II	Resigned	February 14, 2018
Terminations - Contractors			
Name	**Title**	**Action**	**Date**
n/a			
Transfers			
Name	Title	Action	Date of Action
Chisholm, Christine	Regional Planner III	Transfer from Department of Agricultural Resources	March 4, 2018
Clark, Fletcher	Game Biologist III	Transfer from the Department of Conservation and Recreation	October 15, 2017
Huguenin, Michael	Assistant Director of Wildlife	Transfer from Assistant Director of Field Operations	October 29, 2017
Schluter, Everose	Environmental Analyst V	Promotion / Transfer to Executive Office of Energy and Environmental Affairs	November 26, 2017
Young, Cameron	Wildlife Technician II	Transfer to Palmer Fish Hatchery from the Sandwich Fish Hatchery	April 29, 2018

Promotions			
Name	**Title**	**Action**	**Date**
Caljouw, Caren	Conservation Biologist IV	Promotion	December 24, 2017
Gahagan, Joshua	Wildlife Technician II	Promotion	July 9, 2017
Leddick, Jesse	Environmental Analyst V	Promotion	February 18, 2018
McCarthy, Susan	Game Biologist III	Promotion	May 27, 2018
Moruzzi, Trina	Assistant Director of Field Operations	Promotion	November 12, 2017
Olanyk, Todd	Central District Supervisor - Environmental Analyst V	Promotion	June 10, 2018
Tisa, Mark	Director of Fisheries and Wildlife	Promotion	April 29, 2018
Reclassifications			
Name	**Professional Titles**	**Action**	**Effective Date**
Buelow, Christopher	Conservation Biologist IV	Reclassification	January 21, 2018
Durand, Jill	Clerk IV	Reclassification	January 21, 2018
Hubbard, Colleen	Clerk IV	Reclassification	January 21, 2018
Leddick, Jesse	Conservation Biologist IV	Reclassification	January 21, 2018
Manty Debra	Clerk IV	Reclassification	January 21, 2018
Manzer, David	Accountant I	Reclassification	October 25, 2017
Ostertag, Sue	Clerk IV	Reclassification	January 21, 2018
Silva, Debra	Clerk IV	Reclassification	January 21, 2018

Financial Report

Kris McCarthy
Associate Director of Administration & Finance

SUMMARY
REVENUE AND FUND EQUITY
INLAND FISH/GAME FUND
07/01/2017 - 06/30/2018

Fishing,Hunting, and Trapping Licenses	$	5,329,071.60
Archery Stamps	$	172,846.00
Primitive Firearm Stamps	$	184,713.30
Waterfowl Stamps	$	53,367.25
Wildlands Stamps	$	996,115.00
Trap Registrations	$	2,610.00
Antlerless Deer Permits	$	198,745.00
Bear Permits	$	75,655.00
Turkey Permits	$	124,065.00
Special Licenses,Tags and Posters	$	40,424.00
Magazine Subscriptions	$	83,817.81
Timber Sales	$	37,017.98
Fines and Penalties	$	3,450.00
Rents	$	61,451.09
Prior Year Refunds	$	-
Donations	$	371,775.85
Miscellaneous Income	$	228,704.19
PAC	$	37,289.00
NSF Charge/Debt. Collection	$	200.00
Total	**$**	**8,001,318.07**
FEDERAL AID REIMBURSEMENTS:		
Dingell-Johnson (Fisheries)	$	1,757,044.44
Pittman-Robertson (Wildlife)	$	5,652,386.13
Total	**$**	**7,409,430.57**
TAXES:		
Gasoline Tax Apportionment	$	1,003,303.24
OTHER FINANCIAL SOURCES:		
Reimbursement for Half-Price Licenses	$	198,757.75
Investment Earnings	$	16,917.13
Total	$	215,674.88
TOTAL REVENUE	**$**	**16,629,726.76**
FUND EQUITY AS OF JUNE 30, 2018	**$**	**10,917,286.65**

LICENSE AND STAMP SALES
07/01/2017-06/30/2018

Code	Type of License	Cost	Quantity		Amount
F1	Resident Citizen Fishing	22.50	114,663	$	2,579,917.50
F2	Resident Citizen Minor Fishing	FREE	7,218	$	-
F3	Resident Citizen Fishing (Age 65-69)	11.25	9,484	$	106,695.00
F4	Resident Cit. Fishing (Over 70)	FREE	14,582	$	-
F4	Resident Cit. Fishing (Disabled)	FREE	379	$	-
F6	Non-Res. Citizen/Alien Fishing	32.50	11,743	$	381,647.50
F7	Non-Res. Citizen/Alien Fishing (3 day)	18.50	3,294	$	60,939.00
F8	Resident Fishing (3 day)	7.50	2,603	$	19,522.50
F9	Non-Resident (Citizen) Minor Fishing	6.50	384	$	2,496.00
	Quabbin 1-Day Fishing	5.00	3,202	$	16,010.00
T1	Resident Citizen Trapping	30.50	659	$	20,099.50
T2	Resident Citizen Minor Trapping	6.50	4	$	26.00
T3	Resident Citizen Trapping (Age 65-69)	15.25	61	$	930.25
H1	Resident Citizen Hunting	22.50	15,340	$	345,150.00
H2	Resident Citizen Hunting (Age 65-69)	11.25	1,002	$	11,272.50
H3	Resident Citizen Hunting (Paraplegics)	FREE	5	$	-
H4	Resident Alien Hunting	22.50	149	$	3,352.50
H5	Non-Res. Cit./Alien Hunting (Big Game)	94.50	3,038	$	287,091.00
H6	Non-Res. Cit./Alien Hunting (Sm. Game)	60.50	1,084	$	65,582.00
H8	Resident (Citizen) Minor Hunting	6.50	1,274	$	8,281.00
S1	Resident Citizen Sporting	40.00	33,567	$	1,342,680.00
S2	Resident Citizen Sporting (Age 65-69)	20.00	3,993	$	79,860.00
S3	Resident Citizen Sporting (Over 70)	FREE	11,502	$	-
S3	Resident Citizen Sporting (Disabled)	FREE	48	$	-
S4	Non - Resident Sporting Paraplegic	FREE	1	$	-
	TOTAL LICENSE SALES (GROSS)		**239,279**	**$**	**5,331,552.25**
	Type of Stamp				
M1	Archery Stamps	5.10	33,896	$	172,869.60
M2	Waterfowl Stamps	5.00	10,677	$	53,385.00
M3	Primitive Firearm Stamps	5.10	36,224	$	184,742.40
W1	Wildlands Stamps	5.00	179,679	$	898,395.00
W2	Non-Resident Wildlands Stamps	5.00	19,544	$	97,720.00
	TOTAL STAMP SALES (GROSS)		**280,020**	**$**	**1,407,112.00**
	Previous Years Stamp Sales				
M1	Archery Stamps		0	$	-
M2	Waterfowl Stamps		0	$	-
M3	Primitive Firearm Stamps		0	$	-
	TOTAL STAMP SALES (GROSS)		**0**	**$**	**-**
	Fees Retained and Adjustments by Clerks			$	(362.45)
	Refunds			$	(2,188.65)
	TOTAL			**$**	**(2,551.10)**
	TOTAL LICENSE/STAMP SALES (NET)			**$**	**6,736,113.15**

SUMMARY		
REVENUES, EXPENDITURES AND FUND EQUITY		
NATURAL HERITAGE AND ENDANGERED SPECIES FUND		
07/01/2017 - 06/30/2018		
REVENUES:		
Natural Heritage and Endangered Species Tax Checkoff Donations	$ 326,312.93	
Sales	$ 5,500.50	
NRCS/Wildlife Habitat Incentives Program (WHIP)	$ 20,000.00	
State Wildlife Grant (SWG)	$ 1,022,036.06	
Other USFWS Grants (ex. NAWCA, Monarch, WNS, Coastal Wetlands)	$ 549,840.75	
Massachusetts Endangered Species Act Fees	$ 353,600.00	
Contracts	$ 8,000.00	
Direct Donations	$ 7,577.51	
Interest	$ 1,512.68	
TOTAL REVENUES:	**$ 2,294,380.43**	
EXPENDITURES:		
Natural Heritage and Endangered Species Program	$ 1,859,142.67	
Tern Restoration	$ 14,619.00	
State Wildlife Grant (Regional)	$ 52,732.90	
TOTAL EXPENDITURES:	**$ 1,926,494.57**	
FUND EQUITY AS OF JUNE 30, 2018	**$ 2,418,577.56**	

Photo by Bill Byrne/MassWildlife

HOW THE SPORTSMEN'S DOLLAR WAS SPENT
INLAND FISH AND GAME FUND
JULY 1, 2017 TO JUNE 30, 2018

PROGRAMS/ASSESSMENTS

Administration:	**FY2018**	
Administration	$ 2,177,669.15	
Information-Education	$ 1,045,783.03	
ISA DCAMM Field Headquarters	$ 73,567.35	
ISA Attorney General	$ 32.48	
Total	$ 3,297,052.01	18%
Fisheries and Wildlife Programs:		
Hatcheries	$ 2,542,137.04	
Game Bird Program	$ 614,053.75	
Seasonals	$ 128,183.96	
Cooperative Units	$ 166,480.90	
Fisheries and Wildlife Management	$ 5,943,282.87	
Total	$ 9,394,138.52	52%
Other Programs:		
Land Acquisitions	$ 1,499,223.25	
Waterfowl Management Program	$ 42,708.00	
Hunter Safety Program	$ 511,166.81	
Total	$ 2,053,098.06	11%
Other Assessments:		
Payroll Taxes	$ 140,948.36	
GI and Other Fringe Benefits	$ 3,329,361.00	
Total	$ 3,470,309.36	19%
TOTAL EXPENDITURES	$ 18,214,597.95	100%

OTHER EXPENDITURES 07/01/2017 - 06/30/2018

Capital Outlay Funds:		**FY18**
Land Protection : Habitat Management- CR Stewardship	$	682,222.66
Staffing for Land and Infrastructure Programs	$	482,793.50
Hatchery/District/Westborough Field Headquarters Repairs	$	100,084.33
Habitat Grant Program	$	450,030.83
Dam Safety and Repair	$	723,635.45
Bird Island Retstoration	$	65,000.00
TOTAL CAPITAL EXPENDITURES	$	2,503,766.77
Interdepartmental Service Agreements		
Massachusetts Highway Department	$	258,653.48
Department of Environmental Protection (NRD)	$	25,000.00
Department of Conservation and Recreation	$	19,081.01
Natural Heritage and Endangered Species Line Item:	$	247,279.31
Federal Grant Accounts		
New England Cottontail	$	24,495.67
Other Trust Accounts		
Federal Duck Stamp (e-stamp)	$	96,857.50

Photo by Marion Larson/MassWildlife

As part of our agency re-branding efforts, we began installing new signage at our facilities in FY18.

APPENDIX A

Table 1. Daily anadromous fish passage at Holyoke 2017

	American Shad		Blueback Herring		Sea Lamprey		Striped Bass		Atlantic Salmon		Gizzard Shad		Shortnose Sturgeon	
	Daily	YTD	Daily	YTD	Daily	YTD	Daily	YTD	Daily	YTD	Daily	YTD	Daily	YTD
24-Apr	89	89	0	0	0	0	0	0	0	0	0	0	0	0
25-Apr	25	114	0	0	0	0	0	0	0	0	0	0	0	0
26-Apr	52	166	0	0	0	0	0	0	0	0	0	0	0	0
27-Apr	20	186	1	0	0	0	0	0	0	0	0	0	0	0
28-Apr	25	211	0	1	0	0	0	0	0	0	0	0	0	0
29-Apr	3,624	3,835	3	1	0	0	0	0	0	0	0	0	0	0
30-Apr	2,179	6,014	1	4	1	1	0	0	0	0	0	0	0	0
1-May	1990	8004	1	5	2	3	0	0	0	0	0	0	0	0
2-May	2,103	10,107	9	6	11	14	0	0	1	1	4	4	0	0
3-May	197	10,304	1	15	4	18	0	0	0	1	6	10	0	0
4-May	206	10,510	0	16	3	21	0	0	0	1	4	14	0	0
5-May	250	10,760	0	16	0	21	0	0	0	1	1	15	0	0
6-May														
7-May														
8-May														
9-May														
10-May	2,615	13,375	3	16	0	21	0	0	0	1	13	28	0	0
11-May	5,573	18,948	0	19	0	21	0	0	0	1	14	42	0	0
12-May	8,578	27,526	0	19	1	22	0	0	0	1	6	48	0	0
13-May	10,998	38,524	0	19	6	28	0	0	0	1	6	54	0	0
14-May	5,993	44,517	8	19	2	30	1	1	0	1	15	69	0	0
15-May	1,107	45,624	19	27	1	31	2	3	0	1	15	84	0	0
16-May	1,767	47,391	13	46	4	35	0	3	0	1	29	113	0	0
17-May	3,690	51,081	12	59	50	85	1	4	0	1	28	141	0	0
18-May	55,078	106,159	58	71	414	499	1	5	0	1	90	231	0	0
19-May	76,441	182,600	37	129	1,054	1,553	0	5	0	1	110	341	0	0
20-May	58,554	241,154	117	166	854	2,407	1	6	1	2	87	428	0	0
21-May	17,524	258,678	13	283	203	2,610	2	8	1	3	23	451	0	0
22-May	31,481	290,159	4	296	59	2,669	1	9	0	3	1	452	0	0
23-May	43,455	333,614	205	300	294	2,963	6	15	3	6	0	452	0	0
24-May	21,707	355,321	25	505	115	3,078	3	18	1	7	0	452	0	0

25-May	4,088	359,409	1	530	987	4,065	1	19	0	7	0	452	0	0
26-May	12,586	371,995	0	531	27	4,092	4	23	0	7	0	452	0	0
27-May	11,068	383,063	8	531	219	4,311	0	23	0	7	7	459	0	0
28-May	7,639	390,702	10	539	63	4,374	5	28	0	7	9	468	0	0
29-May	13,462	404,164	295	549	110	4,484	2	30	0	7	5	473	0	0
30-May	8,752	412,916	13	844	214	4,698	0	30	0	7	2	475	0	0
31-May	8,656	421,572	2	857	65	4,763	1	31	0	7	0	475	0	0
1-Jun	16,364	437,936	1	859	344	5,107	4	35	0	7	1	476	0	0
2-Jun	9,548	447,484	1	860	204	5,311	2	37	0	7	2	478	0	0
3-Jun	5,092	452,576	1	861	89	5,400	0	37	0	7	1	479	0	0
4-Jun	9,708	462,284	0	862	1,437	6,837	12	49	0	7	5	484	1	1
5-Jun	9,358	471,642	0	862	749	7,586	24	73	0	7	9	493	2	3
6-Jun	898	472,540	1	862	53	7,639	1	74	1	8	2	495	0	3
7-Jun														
8-Jun														
9-Jun	3,310	475,850	0	863	148	7,787	3	77	0	8	36	531	0	3
10-Jun	8,881	484,731	0	863	397	8,184	2	79	0	8	4	535	0	3
11-Jun	10,317	495,048	8	863	2,161	10,345	9	88	0	8	10	545	0	3
12-Jun	10,532	505,580	0	871	3,057	13,402	26	114	0	8	47	592	0	3
13-Jun	6,008	511,588	0	871	3,622	17,024	17	131	0	8	8	600	0	3
14-Jun	3,935	515,523	0	871	2,292	19,316	10	141	1	9	18	618	1	4
15-Jun	9,225	524,748	2	871	745	20,061	14	155	0	9	9	627	2	6
16-Jun	1,527	526,275	1	873	283	20,344	4	159	0	9	6	633	1	7
17-Jun	1,215	527,490	0	874	385	20,729	5	164	0	9	2	635	0	7
18-Jun	2,461	529,951	0	874	500	21,229	6	170	0	9	3	638	0	7
19-Jun	1,567	531,518	0	874	204	21,433	3	173	0	9	3	641	0	7
20-Jun	379	531,897	0	874	39	21,472	23	196	0	9	5	646	0	7
21-Jun	296	532,193	0	874	28	21,500	11	207	0	9	9	655	0	7
22-Jun														
23-Jun	1,062	533,255	0	874	10	21,510	7	214	1	10	16	671	2	9
24-Jun	613	533,868	1	874	5	21,515	9	223	0	10	15	686	0	9
25-Jun	1,339	535,207	0	875	5	21,520	6	229	0	10	12	698	0	9
26-Jun	138	535,345	0	875	3	21,523	23	252	0	10	0	698	0	9
27-Jun	428	535,773	0	875	3	21,526	11	263	0	10	5	703	3	12
28-Jun	183	535,956	0	875	0	21,526	8	271	0	10	8	711	1	13
29-Jun	186	536,142	0	875	0	21,526	3	274	0	10	3	714	7	20
30-Jun	89	536,231	0	875	0	21,526	3	277	0	10	2	716	1	21

1-Jul	29	536,260	0	875	0	21,526	1	278	0	10	1	717	2	23
2-Jul														
3-Jul														
4-Jul														
5-Jul														
6-Jul														
7-Jul														
8-Jul														
9-Jul	112	536,372	0	875	0	21,526	32	310	0	10	15	732	0	23
10-Jul	122	536,494	0	875	0	21,526	5	315	0	10	5	737	1	24
11-Jul	148	536,642	0	875	0	21,526	16	331	0	10	1	738	0	24
12-Jul	0	536,642	0	875	0	21,526	3	334	0	10	0	738	0	24
13-Jul														
14-Jul	28	536,670	0	875	0	21,526	4	338	0	10	0	738	5	29

20-Jul	18	47
21-Jul	2	49
24-Jul	4	53
25-Jul	7	60
26-Jul	5	65
28-Jul	4	69
31-Jul	4	73
1-Aug	3	76
21-Aug	2	78
22-Aug	1	79
5-Sep	1	80
6-Sep	1	81
19-Sep	1	82
22-Sep	1	83
10-Oct	1	84
12-Oct	1	85

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Table 2. Anadromous fish passage recorded at the Holyoke fishlift, Connecticut River, Massachusetts 1955-2017

Year	American Shad	Blueback Herring	Atlantic Salmon	Striped Bass	Sea Lamprey	Gizzard Shad	Year	American Shad	Blueback Herring	Atlantic Salmon	Striped Bass	Sea Lamprey	Gizzard Shad
1955	4,900	-	-	-	-	-	1987	280,000	360,000	208	521	23,000	94
1956	7,700	-	-	-	-	-	1988	290,000	340,000	72	256	16,000	95
1957	8,800	16	1	-	-	-	1989	350,000	290,000	80	923	15,000	294
1958	5,700	29	1	-	2	-	1990	360,000	390,000	188	1,000	22,000	956
1959	15,000	20	-	-	73	-	1991	520,000	410,000	152	1,200	41,000	486
1960	15,000	796	2	-	17	-	1992	720,000	310,000	368	327	28,000	1,100
1961	23,000	1,200	-	-	42	-	1993	340,000	100,000	167	194	23,000	341
1962	21,000	19	-	-	209	-	1994	181,000	32,000	256	159	30,000	165
1963	31,000	32	-	-	64	-	1995	190,000	110,000	150	1,300	18,000	2,000
1964	35,000	13	-	-	537	-	1996	276,000	55,000	202	537	45,000	1,100
1965	34,000	53	-	-	26	-	1997	299,000	64,000	94	679	32,000	2,100
1966	16,000	54	-	-	2	-	1998	316,000	11,000	196	492	97,000	1,100
1967	19,000	356	-	-	46	-	1999	194,000	2,700	91	859	20,000	35,000
1968	25,000	-	-	-	-	-	2000	225,000	11,000	50	489	21,000	38,000
1969	45,000	10,000	-	-	-	-	2001	273,000	11,000	25	1,200	49,000	5,500
1970	66,000	1,900	-	-	-	-	2002	375,000	2,000	34	1,100	74,000	3,100
1971	53,000	302	-	-	-	-	2003	287,000	2,700	28	881	53,000	859
1972	26,000	188	-	-	-	-	2004	191,000	145	34	259	59,000	287
1973	25,000	302	-	-	-	-	2005	117,000	534	131	233	28,000	132
1974	53,000	504	-	-	-	-	2006	155,000	21	118	144	18,000	127
1975	110,000	1,600	-	-	23,000	-	2007	159,000	75	106	243	40,000	75
1976	350,000	4,700	-	-	32,000	-	2008	153,000	84	80	617	57,000	127
1977	200,000	33,000	2	-	52,000	-	2009	161,000	40	61	668	19,000	68
1978	140,000	38,000	23	-	43,000	-	2010	164,000	76	41	298	40,000	371
1979	260,000	40,000	19	103	31,000	-	2011	244,000	138	72	138	19,000	423
1980	380,000	200,000	126	148	34,000	-	2012	495,000	39	29	336	14,000	337
1981	380,000	420,000	319	510	53,000	-	2013	393,000	976	69	250	22,000	827
1982	290,000	590,000	11	231	26,000	-	2014	373,000	976	27	69	22,000	410

1983	530,000	450,000	25	346	29,000	-	2015	413,000	87	13	21	22,000	84
1984	500,000	480,000	66	110	22,000	-	2016	386,000	137	3	638	35,000	598
1985	480,000	630,000	285	369	40,000	-	2017	536,670	875	10	338	21,526	738
1986	350,000	520,000	260	187	20,000	27							

Table 3. Temporal characteristics of American shad passage at Holyoke, 2017

Cumulative Percentage of Total American Shad Passage

	25%	50%	75%	90%	Highest Day
Holyoke Fishlift:					
Day*	26	29	36	48	26
Date	5/19	5/22	5/29	6/10	5/19

* Day one is 24 April, the first day shad were lifted at the Holyoke fish passage facility.

Table 4. Population age structure of American shad sampled at the Holyoke fishlift 2017. (from CT DEP)

2017 American Shad Age Structure at the Holyoke Lift							
Age	**3**	**4**	**5**	**6**	**7**	**Total**	**% Rpt Spawn**
%Bucks	9.9%	28.1%	50.4%	10.7%	0.8%		5.8%
Shad (n)	21,051	59,644	107,008	22,805	1,754	212,262	
		4	**5**	**6**	**7**		**% Rpt Spawn**
%Roes		12.3%	47.2%	37.7%	2.8%		11.3%
Shad (n)		21,299	81,919	65,535	4,915	173,669	
	3	**4**	**5**	**6**	**7**		**% Rpt Spawn**
% All	5.3%	20.7%	48.9%	23.3%	1.8%		8.4%
Shad (n)	20,402	79,906	188,715	90,107	6,801	385,930	

Table 5. Holyoke fish lift, spring, 2017. American Shad trap and truck contributions; recipients included Connecticut Department of Energy and Environmental Protection (CT), Rhode Island Division of Fish and Wildlife (RI), Conte Anadromous Fish Research Center (USGS-CAFL), US Fish and Wildlife Service (USFWS), and Normandeau Associates (NAI).

Date	CT	RI	USFWS	USGS	Sums
25-Apr	.	.	.	7	7
2-May	.	.	.	109	109
4-May	.		7	.	7
11-May	.	80	.	.	80
15-May	.	.	.	15	15
16-May	.	.	.	40	40
18-May	.	78	.	66	144
19-May	.	85	.	103	188
22-May	80	85	.	98	263
23-May	.	80	.	65	145
24-May	80	81	.	116	277
25-May	30	80	.	75	185
26-May	.	80	.	.	80
30-May	.	.	.	110	110
31-May	80	.	.	.	80
1-Jun	.	.	.	39	39
2-Jun	.	.	.	46	46
5-Jun	.	.	.	43	43
6-Jun	.	.	.	41	41
11-Jun	.	.	67	.	67
12-Jun	80	.	.	100	180
13-Jun	80	80	.	193	353
14-Jun	.	80	191	121	392
19-Jun	.	.	.	47	47
20-Jun	.	.	80	.	80
21-Jun	.	.	195	46	241
23-Jun	.	.	141	.	141
26-Jun	.	.	67	.	67
27-Jun	.	.	80	.	80
Totals	430	809	828	1,480	3,547

Table 6. Holyoke Dam upstream American eel passage monitoring, 2017.

	Table A-1. Holyoke Dam upstream American Eel passage monitoring, 2017. Daily collections from eel ramps deployed in the spillway fish lift entrance channel, tailrace entrance fish lift entrance channel, upper stilling basin, Bascule Gate apron, and South Hadley shore. Data include date of collection, number of eels collected, and catch-per-unit-of-effort (CPUE, N eels/h fished).								
	Tailrace Fish Lift Ramp		Spillway Fish Lift Ramp		Stilling Basin Ramp		South Hadley Ramp		Total
Date	N Eels	CPUE (N/h)	N Eels	CPUE (N/h)	N Eels	CPUE (N/h)	N Eels	CPUE (N/h)	N Eels
25-May	.	.	0	0	0	0	.	.	0
26-May	.	.	0	0	0	0	.	.	0
27-May	.	.	0	0	0	0	.	.	0
28-May	.	.	0	0	0	0	.	.	0
29-May	.	.	0	0	0	0	.	.	0
30-May	.	.	0	0	0	0	.	.	0
31-May	.	.	0	0	0	0	.	.	0
2-Jun	.	.	0	0	0	0	.	.	0
3-Jun	.	.	0	0	0	0	.	.	0
4-Jun	.	.	0	0	0	0	.	.	0
5-Jun	.	.	0	0	0	0	.	.	0
6-Jun	.	.	0	0	0	0	.	.	0
9-Jun	.	.	0	0	3	0	.	.	3
10-Jun	0	0	0	0	0	0	.	.	0
11-Jun	4	0.3	0	0	3	0.2	.	.	7
12-Jun	0	0	0	0	0	0	.	.	0
13-Jun	0	0	0	0	0	0	.	.	0
14-Jun	0	0	0	0	0	0	.	.	0
15-Jun	0	0	0	0	12	0.9	.	.	12
16-Jun	0	0	0	0	5	0.2	.	.	5
17-Jun	9	0.6	0	0	17	1.2	.	.	26
18-Jun	1	0	0	0	7	0.3	.	.	8
19-Jun	71	3.4	0	0	0	0	.	.	71
20-Jun	75	4.2	.	.	0	0	.	.	75
21-Jun	133	5.6	0	0	356	14.8	0	0	489
23-Jun	238	5	0	0	684	13.3	362	7.6	1,284
24-Jun	73	3.9	0	0	427	29.4	120	4	620
25-Jun	245	10	0	0	183	7.6	633	25.3	1,061

26-Jun	227	8.8	0	0	199	7.8	54	2.3	480
27-Jun	98	3.3	0	0	416	18.5	9	0.4	523
28-Jun	66	3.4	0	0	598	35.3	57	2.8	721
29-Jun	54	3.4	0	0	122	8	60	2.9	236
30-Jun	36	1.5	0	0	0	0	58	3	94
1-Jul	30	1.3	0	0	72	3	34	1.2	136
2-Jul	0	0	0	0	91	3.8	0	0	91
3-Jul	.	.	0	0	58	2.7	.	.	58
5-Jul	926	18.8	0	0	30	0.6	.	.	956
6-Jul	56	2.8	0	0	0	0	17	0.9	73
7-Jul	.	.	.	.	190	10.4	462	20.1	652
8-Jul	.	.	.	.	656	27.6	128	5.4	784
9-Jul	.	.	.	.	516	19.8	0	0	516
10-Jul	.	.	.	.	0	0	242	10.3	242
11-Jul	115	5.6	0	0	312	17.6	227	10	654
12-Jul	135	5.1	0	0	58	2	977	37.9	1,170
13-Jul	110	5.6	0	0	74	4.1	96	4.4	280
14-Jul	0	0	0	0	121	5	158	6.7	279
17-Jul	110	1.5	0	0	126	1.8	246	3.4	482
18-Jul	35	1.5	.	.	11	0.5	97	4.2	143
19-Jul	23	1	.	.	13	0.6	9	0.4	45
20-Jul	31	1.3	.	.	13	0.5	.	.	44
21-Jul	9	0.3	.	.	29	1	252	5.3	290
24-Jul	19	0.3	0	0	45	0.7	167	2.4	231
25-Jul	32	1.2	.	.	2	0.1	56	2.3	90
26-Jul	55	2.6	.	.	0	0	8	0.3	63
27-Jul	10	0.5	0	0	0	0	20	0.8	30
28-Jul	15	0.6	0	0	1	0	12	0.5	28
31-Jul	31	0.4	0	0	9	0.1	41	0.6	81
1-Aug	8	0.3	.	.	1	0	10	0.4	19
3-Aug	11	0.2	.	.	35	0.7	51	1.1	97
4-Aug	3	0.1	.	.	1	0	22	1.1	26
6-Aug	2	0	.	.	0	0	19	0.4	21
7-Aug	7	0.3	.	.	9	0.4	5	0.2	21
9-Aug	2	0	.	.	2	0	1	0	5
11-Aug	13	0.3	.	.	0	0	22	0.5	35
14-Aug	8	0.1	.	.	0	0	14	0.2	22
15-Aug	2	0.1	0	0	0	0	3	0.1	5

16-Aug	0	0	0	0	0	0	0	0	0
17-Aug	5	0.2	0	0	1	0	4	0.2	10
18-Aug	4	0.2	0	0	4	0.2	1	0	9
21-Aug	7	0.1	0	0	0	0	4	0.1	11
22-Aug	5	0.2	.	.	1	0	6	0.3	12
23-Aug	16	0.7	0	0	0	0	18	0.8	34
24-Aug	7	0.3	.	.	7	0.3	5	0.2	19
25-Aug	0	0	0	0	0	0	5	0.2	5
28-Aug	.	.	0	0	0	0	12	0.2	12
29-Aug	5	0.2	0	0	0	0	2	0.1	7
30-Aug	2	0.1	0	0	0	0	3	0.1	5
31-Aug	0	0	0	0	0	0	1	0	1
1-Sep	10	0.4	0	0	0	0	3	0.1	13
4-Sep	8	0.1	0	0	0	0	1	0	9
5-Sep	0	0	0	0	2	0.1	3	0.1	5
6-Sep	0	0	0	0	2	0.1	3	0.1	5
7-Sep	9	0.4	0	0	0	0	217	9.2	226
8-Sep	2	0.1	0	0	0	0	100	4.3	102
11-Sep	10	0.1	0	0	0	0	87	1.2	97
12-Sep	14	0.6	0	0	1	0	13	0.6	28
13-Sep	4	0.2	0	0	0	0	31	1.3	35
14-Sep	17	0.7	0	0	0	0	11	0.5	28
15-Sep	14	0.6	0	0	0	0	1	0	15
18-Sep	16	0.2	0	0	0	0	8	0.1	24
19-Sep	0	0	10	0.5	0	0	9	0.4	19
20-Sep	12	0.5	0	0	0	0	7	0.3	19
21-Sep	6	0.3	0	0	0	0	9	0.4	15
22-Sep	10	0.4	0	0	0	0	0	0	10
25-Sep	.	.	.	.	.	.	16	0.2	16
27-Sep	.	.	.	.	.	.	21	0.4	21
29-Sep	.	.	.	.	.	.	22	0.5	22
2-Oct	.	.	.	.	.	.	22	0.3	22
3-Oct	.	.	.	.	.	.	3	0.2	3
4-Oct	24	1.2	0	0	0	0	7	0.3	31
5-Oct	29	1.2	0	0	0	0	8	0.3	37
6-Oct	34	1.4	0	0	3	0.1	5	0.2	42
8-Oct	57	1	0	0	0	0	29	0.5	86
9-Oct	67	2.9	0	0	0	0	11	0.5	78

10-Oct	49	3.1	0	0	0	0	197	12.4	246
11-Oct	0	0	0	0	7	0.3	93	4	100
12-Oct	18	0.8	0	0	0	0	97	4.2	115
13-Oct	22	0.7	0	0	0	0	37	1.2	59
16-Oct	35	0.5	0	0	0	0	29	0.5	64
17-Oct	12	0.4	0	0	0	0	14	0.6	26
18-Oct	3	0.2	0	0	0	0	9	0.4	12
19-Oct	7	0.3	0	0	0	0	4	0.2	11
20-Oct	19	0.8	0	0	0	0	2	0.1	21
23-Oct	61	0.9	0	0	15	0.2	0	0	76
25-Oct	35	0.8	.	.	23	0.5	84	1.8	142
26-Oct	16	0.6	.	.	1	0	.	.	17
27-Oct	4	0.2	.	.	0	0	9	0.2	13
30-Oct	1,600	22.3	0	0	7	0.1	.	.	1,607
2-Nov	0	0	0	0	1	0	0	0	1
3-Nov	0	0	0	0	0	0	0	0	0
6-Nov	6	0.1	0	0	0	0	0	0	6
7-Nov	2	0.1	0	0	0	0	0	0	2
8-Nov	0	0	0	0	0	0	0	0	0
9-Nov	1	0	0	0	1	0	0	0	2
Total N / Mean CPUE	**5,412**	**1.5**	**10**	**0**	**5,583**	**2**	**6,032**	**2.3**	**17,037**

Table 7. Daily fish passage at the Turners Falls Fish Passage Facilities 2017

	American Shad						Sea Lamprey	
	Cabot		Spillway		Gatehouse		Gatehouse	
date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
28-Apr	0	0	0	0	0	0	0	0
29-Apr	0	0	0	0	0	0	0	0
30-Apr	0	0	0	0	0	0	0	0
1-May	10	10	0	0	0	0	0	0
2-May	28	38	4	4	0	0	0	0
3-May	0	38	4	8	6	6	0	0
4-May	0	38	0	8	0	6	0	0
5-May	0	38	0	8	0	6	0	0
6-May	0	38	0	8	2	8	0	0
7-May	1	39	0	8	0	8	0	0
8-May	0	39	0	8	0	8	0	0
9-May	0	39	0	8	0	8	0	0
10-May	3	42	0	8	3	11	0	0
11-May	0	42	0	8	2	13	0	0
12-May	2	44	4	12	62	75	0	0
13-May	154	198	38	50	121	196	0	0
14-May	343	541	14	64	67	263	0	0
15-May	91	632	7	71	28	291	0	0
16-May	61	693	0	71	12	303	0	0
17-May	84	777	0	71	140	443	0	0
18-May	324	1101	56	127	313	756	0	0
19-May	1637	2738	2346	2473	3895	4651	0	0
20-May	3199	5937	2149	4622	5227	9878	3	3
21-May	5241	11178	1330	5952	5547	15425	16	19
22-May	4693	15871	549	6501	3487	18912	33	52
23-May	2388	18259	642	7143	1496	20408	43	95
24-May	2163	20422	397	7540	2055	22463	32	127
25-May	3008	23430	88	7628	1068	23531	28	155
26-May	1072	24502	58	7686	186	23717	19	174
27-May	145	24647	224	7910	255	23972	9	183
28-May	449	25096	663	8573	886	24858	10	193
29-May	1047	26143	346	8919	1644	26502	72	265
30-May	563	26706	242	9161	497	26999	61	326

31-May	703	27409	311	9472	797	27796	14	340
1-Jun	400	27809	68	9540	446	28242	27	367
2-Jun	452	28261	88	9628	302	28544	24	391
3-Jun	1158	29419	1991	11619	5072	33616	47	438
4-Jun	1201	30620	994	12613	1736	35352	95	533
5-Jun	820	31440	419	13032	1443	36795	87	620
6-Jun	314	31754	167	13199	243	37038	34	654
7-Jun	1	31755	1	13200	3	37041	0	654
8-Jun	3	31758	2	13202	5	37046	0	654
9-Jun	59	31817	12	13214	60	37106	35	689
10-Jun	333	32150	611	13825	1501	38607	114	803
11-Jun	578	32728	785	14610	2154	40761	233	1036
12-Jun	861	33589	307	14917	797	41558	744	1780
13-Jun	1860	35449	681	15598	1105	42663	882	2662
14-Jun	1287	36736	408	16006	1027	43690	587	3249
15-Jun	1195	37931	55	16061	1173	44863	1875	5124
16-Jun	1874	39805	29	16090	324	45187	1328	6452
17-Jun	1191	40996	86	16176	942	46129	879	7331
18-Jun	651	41647	85	16261	1250	47379	920	8251
19-Jun	477	42124	38	16299	171	47550	656	8907
20-Jun	116	42240	13	16312	109	47659	162	9069
21-Jun	0	42240	0	16312	8	47667	9	9078
22-Jun	129	42369	164	16476	453	48120	30	9108
23-Jun	225	42594	107	16583	230	48350	28	9136
24-Jun	91	42685	59	16642	113	48463	25	9161
25-Jun	116	42801	12	16654	33	48496	13	9174
26-Jun	140	42941	21	16675	39	48535	10	9184
27-Jun	223	43164	52	16727	94	48629	4	9188
28-Jun	21	43185	8	16735	71	48700	24	9212
29-Jun	44	43229	1	16736	13	48713	8	9220
30-Jun	37	43266	2	16738	10	48723	0	9220
1-Jul	1	43267	2	16740	4	48727	3	9223
2-Jul	0	43267	0	16740	0	48727	0	9223
3-Jul	0	43267	0	16740	0	48727	0	9223
4-Jul	1	43268	0	16740	0	48727	0	9223
5-Jul	0	43268	0	16740	0	48727	0	9223
6-Jul	1	43269	1	16741	0	48727	0	9223
7-Jul	0	43269	0	16741	0	48727		

Total	**43269**		**16741**		**48727**		**9223**	

Table 8. Historic Fish Passage at the Turners Falls Fish Passage Facilities

Year	Location	American Shad	Blueback Herring	Striped Bass	Sea Lamprey	Atlantic Salmon	Gizzard* Shad
1980	Cabot	687	0	11	187	0	
	Spillway	5	0	0	0	0	
	Gatehouse	298	0	1	66	1	
1981	Cabot	224	0	0	1,622	7	
	Spillway**						
	Gatehouse	200	0	0	935	8	
1982	Cabot						
	Spillway**						
	Gatehouse	11	4	0	210	0	
1983	Cabot	26,697	106	6	859	0	
	Spillway	263	1	1	649	0	
	Gatehouse	12,705	28	7	703	0	
1984	Cabot	1,831	4	0	334	1	
	Spillway	4,563	12	0	851	1	
	Gatehouse	4,333	21	0	683	1	
1985	Cabot	31,000	1,726	0	3,198	2	
	Spillway	843	243	0	3,185	3	
	Gatehouse	3,855	301	0	1,809	3	
1986	Cabot	22,144	7,091	0	1,424	5	
	Spillway	5,857	6,248	0	2,230	4	
	Gatehouse	17,858	9,578	0	1,961	10	
1987	Cabot	33,114	2,866	0	1,324	2	
	Spillway	3,679	2,841	0	2,921	3	
	Gatehouse	18,959	5,091	0	2,590	12	
1988	Cabot	28,546	349	0	335	2	
	Spillway	3,354	865	0	1,912	2	
	Gatehouse	15,787	1,079	0	1,175	7	
1989	Cabot	14,403	199	0	578	1	
	Spillway	1,494	279	0	947	0	
	Gatehouse	9,511	510	1	868	2	
1990	Cabot	31,056	711	0	1,304	8	1
	Spillway	5,898	768	0	1,013	2	0
	Gatehouse	27,908	1,585	0	1,301	16	13
1991	Cabot	87,168	6,433	1	2,089	2	0

	Spillway	6,282	2,718	0	3,026	2	0
	Gatehouse	54,656	7,522	3	4,090	4	1
1992	Cabot	94,046	1,765	1	1,836	9	0
	Spillway	11,760	884	0	3,275	6	0
	Gatehouse	60,089	2,157	2	2,710	14	7
1993	Cabot	21,045	243	0	711	7	0
	Spillway	898	90	0	2,082	3	0
	Gatehouse	10,221	278	0	1,637	7	0
1994	Cabot**						
	Spillway	1,507	17	0	1,740	1	0
	Gatehouse	3,729	97	0	1,702	5	0
1995	Cabot	33,938	4,234	0	1,417	2	1
	Spillway	543	31	0	1,372	0	0
	Gatehouse	18,369	2,957	0	1,813	4	4
1996	Cabot**						
	Spillway	2,293	13	0	2,651	4	0
	Gatehouse	16,192	515	0	4,556	3	3
1997	Cabot	22,518	231	0	2,374	2	4
	Spillway	3,473	15	0	2,219	1	3
	Gatehouse	9,216	128	0	2,265	2	2
1998	Cabot	14,947	2	0	8,707	6	1
	Spillway	4,721	0	0	8,642	2	2
	Gatehouse	10,527	4	0	7,579	5	2
1999	Cabot	11,501	5	0	2,014	2	543
	Spillway	4,215	0	8	1,449	2	440
	Gatehouse	6,751	2	0	916	0	275
2000	Cabot	12,289	0	0	1,455	0	9
	Spillway	2,240	0	0	1,962	4	358
	Gatehouse	2,590	0	0	1,350	5	199
2001	Cabot	20,933	0	0	3,678	0	0
	Spillway	2,344	0	0	5,280	0	0
	Gatehouse	1,540	0	0	2,144	0	0
2002	Cabot	7,922	0	0	14,709	0	0
	Spillway	5,372	0	0	12,367	0	0
	Gatehouse	2,870	0	0	10,160	0	0
2003**							
2004	Cabot	5,933	0	0	13,352	0	0

	Spillway	1,980	0	0	5,821	0	0
	Gatehouse	2,192	0	0	8,418	0	0
2005	Cabot	5,404					
	Spillway	1,626					
	Gatehouse	1,581					
2006	Cabot	11,991	1	198	5,377	4	9
	Spillway	2,577	0	153	5,133	8	0
	Gatehouse	1,810	0	46	3,005	7	0
2007	Cabot	11,130	**	**	11,061	5	**
	Spillway	1,793	**	**	5,555	3	**
	Gatehouse	2,248	**	**	15,438	5	**
2008	Cabot	15,089	**	**	**	6	**
	Spillway	627	**	**	**	5	**
	Gatehouse	3,995	**	**	32,035	10	**
2009	Cabot	13,391	**	**	**	0	**
	Spillway	919	**	**	**	5	**
	Gatehouse	3,814	**	**	8,296	8	**
2010	Cabot	30,232	**	**	**		**
	Spillway	2,735	**	**	**		**
	Gatehouse	16,768	**	**	6,352	8	**
2011	Cabot	27,077	**	**	**	2	**
	Spillway	1,966	**	**	**	6	**
	Gatehouse	16,798	**	**	2,032	7	**
2012	Cabot	51,901	**	**	**	2	**
	Spillway	10,608	**	**	**	3	**
	Gatehouse	26,727	**	**	4,503	1	**
2013	Cabot	46,886	**	**	**		**
	Spillway	10,571	**	**	**		**
	Gatehouse	35,494	**	**	6,016		**
2014	Cabot	40,666	**	**	**	3	**
	Spillway	24,262	**	**	**	8	**
	Gatehouse	39,914	**	**	5,553	11	**
2015	Cabot	47,588	**	**	**	3	**
	Spillway	41,835	**	**	**		**
	Gatehouse	58,078	**	**	8,436		**
2016	Cabot	34,709	**	**	**	3	**
	Spillway	19,399	**	**	**		**

	Gatehouse	54,760	**	**	15,128	**
2017	Cabot	43,269	**	**	**	**
	Spillway	16,741	**	**	**	**
	Gatehouse	48,727	**	**	9,223	**

* 1990 was the first year gizzard shad observed using the ladders was recorded.

** Not monitored

Table 9
Daily Fish Counts - West Springfield Fish Ladder 2017

Date	American Shad	Sea Lamprey	Atlantic Salmon	White Sucker	Small-mouth	Brown Trout	Rainbow Trout	Brook Trout	Tiger Trout	Max. H2O Temp. (C°)
7-Apr	0	0	0	0	0	0	0	0	0	no data
8-Apr	0	0	0	0	0	0	0	0	0	no data
9-Apr	0	0	0	0	0	0	0	0	0	no data
10-Apr	0	0	0	0	0	0	0	0	0	no data
11-Apr	0	0	0	0	0	0	0	0	0	8.5
12-Apr	0	0	0	0	0	0	0	0	0	10.0
13-Apr	0	0	0	0	0	0	0	0	0	8.0
14-Apr	0	0	0	0	0	0	0	0	0	9.5
15-Apr	0	0	0	32	0	0	0	0	0	9.0
16-Apr	0	0	0	36	0	0	1	0	0	10.0
17-Apr	0	0	0	306	0	1	0	0	0	11.0
18-Apr	1	0	0	246	1	0	0	0	0	12.0
19-Apr	9	0	0	50	2	0	0	0	0	11.5
20-Apr	2	0	0	3	0	0	0	0	0	11.0
21-Apr	0	0	0	0	0	0	0	0	0	10.5
22-Apr	0	0	0	0	0	0	0	0	0	9.5
23-Apr	0	0	0	0	0	0	0	0	0	10.0
24-Apr	18	0	0	35	0	0	0	0	0	12.5
25-Apr	3	0	0	14	4	0	0	0	0	11.0
26-Apr	0	0	0	4	0	0	0	0	0	11.0
27-Apr	0	0	0	2	1	0	0	0	0	no data
28-Apr	5	0	0	34	5	0	0	1	0	14.0
29-Apr	92	1	0	592	59	0	0	0	0	16.5
30-Apr	112	0	0	50	29	0	0	1	0	14.5
1-May	23	0	0	5	1	0	0	0	0	11.5
2-May	6	5	0	1	0	0	0	1	0	12.0
3-May	0	4	0	6	0	0	0	0	0	13.0
4-May	1	0	0	2	1	0	0	2	0	13.1
5-May	12	0	0	0	0	1	0	0	0	11.0
6-May	0	0	0	0	0	0	0	0	0	no data
7-May	0	3	0	0	0	0	0	0	0	11.5
8-May	0	0	0	0	0	0	0	0	0	11.3
9-May	0	0	0	0	0	0	0	0	0	10.2
10-May	0	0	0	0	0	0	0	1	0	10.3

11-May	8	0	0	0	0	0	0	0	0	10.7
12-May	99	0	0	2	0	1	0	1	1	12.3
13-May	85	0	0	1	8	0	0	0	0	12.3
14-May	3	0	0	0	0	0	0	0	0	10.1
15-May	0	0	0	0	1	0	0	0	0	10.9
16-May	0	0	0	0	0	1	0	2	1	12.7
17-May	8	0	0	28	17	0	0	1	2	15.5
18-May	28	19	0	112	75	0	0	1	1	18.7
19-May	271	66	0	37	20	0	0	0	0	20.1
20-May	260	11	0	33	24	3	0	0	2	18.5
21-May	375	5	0	22	67	0	0	0	0	17.0
22-May	159	3	0	3	14	2	0	3	0	16.3
23-May	15	2	0	0	4	0	0	2	2	14.7
24-May	9	1	0	1	7	0	0	1	1	14.5
25-May	8	2	0	2	15	0	0	1	0	15.5
26-May	1	10	0	8	0	0	0	0	1	14.0
27-May	0	1	0	3	0	0	0	0	0	no data
28-May	25	0	0	1	13	0	0	2	2	15.9
29-May	106	0	0	0	5	0	0	1	1	14.9
30-May	63	0	0	0	0	0	0	4	0	14.0
31-May	4	0	1	0	0	0	0	0	0	13.0
1-Jun	2	0	0	0	0	0	0	0	0	no data
2-Jun	16	1	0	1	4	0	0	0	0	15.0
3-Jun	48	1	1	1	1	0	0	0	1	14.5
4-Jun	155	0	2	1	10	1	0	0	0	15.0
5-Jun	459	0	0	0	5	0	0	0	0	14.5
6-Jun	25	0	0	0	0	0	0	0	0	no data
7-Jun	0	0	0	0	0	0	0	0	0	12.0
8-Jun	0	2	0	0	1	0	0	0	0	14.5
9-Jun	3	2	0	2	5	1	1	0	0	15.0
10-Jun	2	3	0	0	7	0	1	0	0	15.5
11-Jun	438	2	0	2	15	2	0	0	1	18.0
12-Jun	1185	5	0	19	29	2	0	0	0	20.0
13-Jun	839	5	0	29	59	1	0	4	0	23.0
14-Jun	134	5	0	3	6	0	0	0	0	23.0
15-Jun	152	3	0	10	11	2	1	3	1	22.0
16-Jun	80	4	0	0	3	2	1	1	1	20.5

17-Jun	33	2	0	1	4	0	1	1	0	18.5
18-Jun	31	3	0	3	4	0	0	1	0	19.0
19-Jun	47	13	1	1	5	0	0	1	0	21.5
20-Jun	114	11	0	10	1	0	0	0	0	no data
21-Jun	194	26	0	20	15	1	0	0	0	21.0
22-Jun	46	6	0	14	5	0	0	0	0	21.0
23-Jun	59	19	0	8	3	2	0	0	0	22.5
24-Jun	9	10	0	21	9	2	0	0	0	23.5
25-Jun	23	3	0	1	2	0	0	0	0	23.5
26-Jun	8	0	0	0	6	0	1	0	0	22.5
27-Jun	5	0	0	1	3	0	0	0	0	21.0
28-Jun	7	2	0	0	2	1	0	0	0	20.0
29-Jun	14	1	0	0	1	0	0	0	0	20.0
30-Jun	9	0	0	0	1	0	0	0	0	20.0
1-Jul	28	0	0	2	1	0	1	0	0	22.0
2-Jul	6	0	0	0	8	0	1	0	0	23.5
3-Jul	15	0	0	0	11	0	0	0	0	24.5
4-Jul	0	0	0	0	0	0	0	0	0	no data
5-Jul	0	0	0	0	0	0	0	0	0	no data
6-Jul	4	0	0	0	1	0	2	0	0	24.0
7-Jul	3	0	0	0	2	0	0	0	0	22.0
8-Jul	0	0	0	0	0	0	0	0	0	no data
9-Jul	0	0	0	0	0	0	0	0	0	no data
10-Jul	0	0	0	0	0	0	0	0	0	no data
11-Jul	0	0	0	0	0	0	0	0	0	no data
12-Jul	0	0	0	0	0	0	0	0	0	no data
13-Jul	0	0	0	0	0	0	0	0	0	no data
14-Jul	0	0	0	0	0	0	0	0	0	-
Total	**6,004**	**262**	**5**	**1,821**	**613**	**26**	**11**	**36**	**18**	

American Shad	Sea Lamprey	Atlantic Salmon	White Sucker	Small-mouth	Brown Trout	Rainbow Trout	Brook Trout	Tiger Trout

Table 10. Historic yearly passage totals, Westfield River fish passage facility, West Springfield, Massachusetts, 1992-2016.

Date	American Shad	Blueback Herring	Sea Lamprey	Striped Bass	Atlantic Salmon	Gizzard Shad	White Sucker	Small-mouth	Brown Trout	Rainbow Trout	Brook Trout	Tiger Trout
*1992					2							
*1993					10							
*1994					7							
*1995					6							
1996	1,413	1	4,699	0	19	0	4,699	110	12	91	7	0
1997	1,012	-	2,255	0	37	0	2,255	64	77	8	12	0
1998	2,292	2	1,756	5	47	1	5,515	149	210	18	42	44
1999	2,668	-	643	0	17	1	1,227	109	162	3	23	103
2000	3,558	-	2,040	0	11	122	3,158	207	77	9	9	44
2001	4,720	2	2,345	2	8	0	3,735	129	116	18	8	34
2002	2,762	4	3,638	2	5	1	2,242	146	160	9	14	90
2003	1,957	5	404	0	6	0	1,832	155	90	2	4	29
2004	913	1	1,171	0	12	0	2,789	148	77	8	6	75
2005	1,237	0	818	0	27	0	1,161	201	58	29	5	28
2006	1,534	0	1,276	1	34	0	3,447	188	39	10	7	69
2007	4,497	0	1,797	0	21	0	2,280	133	44	11	15	21
2008	3,212	0	1,220	0	30	0	1,757	246	34	0	11	6
2009	1,395	0	538	0	2	0	1,865	260	21	15	5	7
2010	3,444	4	447	0	3	0	954	185	24	2	11	21
2011	5,029	0	1,590	0	9	0	1,544	496	24	10	5	38
2012	10,373	3	392	0	6	176	1,529	326	50	6	13	34
2013	4,938	0	729	0	11	0	1,241	620	37	3	11	56
2014	4,787	4	1,127	0	2	0	1,663	290	65	15	33	59
2015	3,383	0	218	0	3	0	2,065	341	54	4	34	19
2016	6,003	0	456	1	1	0	1,023	601	49	11	35	13
2017	6,004	5	262	1	5	0	2,176	613	26	11	36	18

*1992-1995 Adult salmon were netted at the base of the dam.

Table 11. 2017 Anadromous Fish Passage at Essex Dam, Lawrence, MA

Date	American Shad	River Herring	Sea Lamprey	Atlantic Salmon	Gizzard G Shad	Striped S Bass
4/17	-	-	-	-	-	-
4/18	16	-	-	-	-	-
4/19	-	24	-	-	-	-
4/20	-	27	-	-	-	-
4/21	-	19	-	-	-	-
4/22	-	34	-	-	-	-
4/23	2	575	-	-	-	-
4/24	-	136	-	-	-	-
4/25	1	28	-	-	-	-
4/26	-	168	-	-	-	-
4/27	-	234	-	-	-	-
4/28	-	78	-	-	-	-
4/29	3	232	3	-	-	-
4/30	1	176	4	-	-	-
5/1	-	1,130	-	-	-	-
5/2	-	118	-	-	-	-
5/3	3	573	-	-	-	-
5/4	3	155	-	-	-	-
5/5	3	512	-	-	-	-
5/6	3	83	-	-	-	-
5/7	3	23	-	-	-	-
5/8	3	18	-	-	-	-
5/9	-	116	-	-	-	-
5/10	8	170	-	-	-	-
5/11	14	39	-	-	-	1
5/12	21	156	-	-	-	7
5/13	32	130	-	-	-	-
5/14	27	10	1	-	-	4
5/15	77	3,852	-	-	-	20
5/16	-	-	-	-	-	-
5/17	-	-	-	-	-	-
5/18	917	44	6	-	-	44
5/19	983	23,839	136	-	-	28

5/20	945	38,171	170	1	-	16
5/21	857	7,968	105	-	-	9
5/22	2,408	3,106	63	-	-	23
5/23	2,957	3,819	69	-	-	48
5/24	3,810	1,826	16	-	-	36
5/25	3,459	3,825	39	-	-	39
5/26	2,168	91	101	-	-	52
5/27	1,503	31	5	-	-	109
5/28	990	16	7	-	-	37
5/29	732	11	3	-	-	47
5/30	920	4	5	-	-	52
5/31	887	1	3	-	-	25
6/1	1,891	12	76	-	-	59
6/2	1,761	17	45	-	-	57
6/3	1,722	1	32	-	-	84
6/4	2,463	3	16	-	-	34
6/5	2,430	6	80	-	-	61
6/6	649	3	9	-	-	29
6/7	727	1	-	-	-	71
6/8	-	-	-	-	-	-
6/9	110	2	5	-	-	36
6/10	791	-	9	-	-	46
6/11	430	1	40	-	-	36
6/12	320	-	102	-	-	14
6/13	304	-	184	1	-	4
6/14	384	-	177	1	-	11
6/15	3,384	3	162	-	-	24
6/16	3,466	-	83	1	-	62
6/17	3,845	-	20	-	-	98
6/18	2,855	-	81	-	-	98
6/19	2,121	-	105	-	-	61
6/20	1,521	-	48	-	-	39
6/21	930	-	23	-	-	71
6/22	952	-	14	-	-	59
6/23	580	-	3	-	-	47
6/24	847	-	3	-	-	61
6/25	901	-	2	-	-	39

6/26	622	-	1	-	-	39
6/27	325	-	-	-	-	20
6/28	537	-	-	-	-	29
6/29	456	-	-	-	-	7
6/30	255	-	-	-	-	18
7/1	304	-	-	-	-	28
7/2	184	-	-	-	-	8
7/3	11	-	-	-	-	21
7/4	106	-	-	-	-	20
7/5	4	-	-	-	-	8
7/6	11	-	-	-	-	5
7/7	105	-	-	-	-	2
7/8	239	-	-	-	-	2
7/9	141	-	-	-	-	1
7/10	82	-	-	1	-	9
7/11	88	-	-	-	-	6
7/12	151	-	-	-	-	9
7/13	57	-	-	-	-	18
7/14	30	-	-	-	-	12
Total	62,848	91,617	2,056	5	-	2,060

	American Shad	River Herring	Sea Lamprey	Atlantic Salmon	Gizzard G Shad	Striped S Bass

Table 12: Historic Anadromous Fish Passage at Essex Dam, Lawrence, MA

Year	Atlantic Salmon[1]	American Shad	River Herring[2]	Striped Bass	Sea Lamprey	Gizzard Shad
1982	16	0	0	0	0	
Lifts for seven weeks in fall only						
1983	88	5,500	4,800	50	2,800	
1984	104	5,500	1,800	40	2,000	
1985	212	13,000	23,000	110	18,000	
1986	98	18,000	16,000	64	13,000	
1987	129 (6) *	17,000	77,000	133	18,000	
1988	65	12,000	360,000	86	8,900	
1989	85	7,900	379,000	262	12,000	
1990	243	6,000	250,000	377	8,300	
1991	331	16,000	380,000	632	10,000	
1992	197	21,000	102,000	424	18,000	
1993	61	8,600	14,000	169	11,000	
1994	17	4,300	89,000	426	5,000	23
1995	34	14,000	33,000	1,800	4,000	224
1996	69	11,000	51	584	3,600	6
1997	67	22,000	362	2,200	8,600	180
1998	123	28,000	1,400	1,400	4,000	58
1999	191	57,000	7,900	843	9,700	208
2000	85	69,000	19,000	1,100	11,000	3,100
2001	84	75,000	1,600	511	3,700	57
2002	56	55,000	526	1,900	8,100	158
2003	120	53,000	11,000	979	2,200	50
2004	131	45,000	15,000	806	6,700	17
2005	31	6,456	98	257	848	1
2006	49	574	1,105	-	-	0
2007	73	15,876	1,169	56	1,399	1
2008	123	24,936	108	42	4,873	12
2009	78	23,229	1,456	46	2,041	0
2010	85	10,442	518	59	3,433	6
2011	402	13,835	740	0	2,571	2
2012	137	21,396	8,992	139	2,067	11
2013	22	37,166	17,359	103	548	11
2014	41	34,711	33,517	129	4,923	29
2015	13	89,421	128,692	248	5,035	25

2016	6	67,528	417,240	1,603	5,164	112
2017	5	62,848	91,617	2,060	2,056	0

1. Captured and transported to Nashua National Fish Hatchery for broodstock.

2. River herring is an undetermined mix of both alewife and blueback herring.

* In addition to the 129 salmon captured, 6 salmon escaped the fish trap.

** In addition to the 17 salmon captured, 2 salmon escaped and 2 were illegally taken by angling.

Table 13. Fish passage at the Pawtucket Dam Fishlift, Lowell, MA in 2017.

Date	American Shad		Atlantic Salmon		River Herring		Sea Lamprey	
25-Apr	5	5	0	0	9	9	0	0
26-Apr	1	6	0	0	5	14	0	0
27-Apr	4	10	0	0	34	48	0	0
28-Apr	21	31	0	0	7	55	0	0
29-Apr	42	73	0	0	125	180	0	0
30-Apr	28	101	0	0	95	275	0	0
1-May	13	114	0	0	30	305	0	0
2-May	1	115	0	0	22	327	0	0
3-May	8	123	0	0	33	360	0	0
4-May	16	139	0	0	120	480	0	0
5-May	1	140	1	1	73	553	0	0
6-May	3	143	0	1	0	553	0	0
7-May	17	160	3	4	203	756	0	0
8-May	8	168	0	4	60	816	0	0
9-May	0	168	0	4	16	832	0	0
10-May	0	168	0	4	37	869	0	0
11-May	0	168	0	4	1	870	0	0
12-May	0	168	0	4	17	887	0	0
13-May	0	168	0	4	0	887	0	0
14-May	0	168	0	4	0	887	0	0
15-May	0	168	0	4	362	1249	0	0
16-May	0	168	0	4	0	1249	0	0
17-May	0	168	0	4	0	1249	0	0
18-May	4	172	0	4	83	1332	0	0
19-May	0	172	0	4	132	1464	0	0
20-May	2	174	0	4	167	1631	0	0
21-May	4	178	0	4	292	1923	4	4
22-May	8	186	0	4	475	2398	4	8
23-May	100	286	0	4	390	2788	1	9
24-May	140	426	0	4	315	3103	4	13
25-May	155	581	0	4	35	3138	2	15

26-May	196	777	0	4	32	3170	1	16
27-May	3	780	0	4	46	3216	8	24
28-May	2	782	0	4	140	3356	1	25
29-May	6	788	0	4	25	3381	1	26
30-May	24	812	0	4	2	3383	0	26
31-May	1	813	0	4	0	3383	0	26
1-Jun	3	816	0	4	2	3385	3	29
2-Jun	7	823	0	4	77	3462	4	33
3-Jun	41	864	0	4	62	3524	8	41
4-Jun	46	910	0	4	5	3529	3	44
5-Jun	105	1015	0	4	0	3529	2	46
6-Jun	83	1098	0	4	0	3529	7	53
7-Jun	11	1109	0	4	10	3539	0	53
8-Jun	0	1109	0	4	0	3539	0	53
9-Jun	1	1110	0	4	0	3539	3	56
10-Jun	1	1111	1	5	0	3539	1	57
11-Jun	0	1111	0	5	0	3539	0	57
12-Jun	28	1139	0	5	0	3539	8	65
13-Jun	71	1210	0	5	0	3539	9	74
14-Jun	46	1256	0	5	2	3541	20	94
15-Jun	59	1315	0	5	0	3541	25	119
16-Jun	135	1450	0	5	0	3541	5	124
17-Jun	156	1606	0	5	0	3541	1	125
18-Jun	188	1794	0	5	0	3541	5	130
19-Jun	255	2049	0	5	0	3541	2	132
20-Jun	235	2284	0	5	0	3541	12	144
21-Jun	225	2509	1	6	0	3541	5	149
22-Jun	140	2649	0	6	0	3541	3	152
23-Jun	123	2772	0	6	0	3541	0	152
24-Jun	60	2832	0	6	0	3541	2	154
25-Jun	33	2865	0	6	0	3541	0	154
26-Jun	140	3005	0	6	0	3541	0	154
27-Jun	111	3116	0	6	0	3541	0	154
28-Jun	57	3173	0	6	0	3541	0	154
29-Jun	115	3288	0	6	0	3541	0	154
30-Jun	44	3332	0	6	0	3541	0	154
1-Jul	51	3383	0	6	0	3541	0	154

2-Jul	31	3414	0	6	0	3541	0	154
3-Jul	31	3445	0	6	0	3541	0	154
4-Jul	4	3449	0	6	0	3541	0	154
5-Jul	11	3460	0	6	0	3541	0	154
6-Jul	9	3469	0	6	0	3541	0	154
7-Jul	14	3483	0	6	0	3541	0	154
8-Jul	30	3513	0	6	0	3541	0	154
9-Jul	50	3563	0	6	0	3541	0	154
10-Jul	43	3606	0	6	0	3541	0	154
11-Jul	51	3657	0	6	0	3541	0	154
12-Jul	0	3657	0	6	0	3541	0	154
13-Jul	35	3692	0	6	0	3541	0	154
14-Jul	7	3699	0	6	0	3541	0	154
15-Jul	0	3699	0	6	0	3541	0	154

total	3,699	6	3,541	154	
	American shad	Atlantic Salmon	River Herring	Sea Lamprey	

Table 14. Historic fish passage at the Pawtucket fishway and ladder, Lowell, MA.

(0-999 fish are reported to the nearest individual: 1,000-9,999 to the nearest 100: 10,000-99,999 to the nearest 1,000: 100,000 or greater to the nearest 10,000).

Year	American shad	River herring	Sea lamprey	Striped bass
1986*	1,600	570	910	0
1987	3,900	31,000	1,900	2
1988	1,300	32,000		
1989	922	37,000	1,900	1
1990**	443	9,900	169	4
1991				
1992***	6,600	34,000	200	0
1993	1,700	4,300	1,500	0
1994****	383	34,000	340	0
1995	5,300	12,000	920	18
1996*****	1,300	292	395	4
1997	4,400	20	2,000	26
1998	4,200	13	545	5
1999	16,000	2,900	3,700	17
2000	13,000	673	2,300	66
2001	7,700	58	606	16
2002	5,300	0	2,000	32
2003	6,600	194	822	51
2004	11,000	7,500	2,200	129
2005	716	201	185	7
2006	0	27	9	0
2007	1,700	0	127	2
2008	4,200			
2009	2,800	139	260	2
2010	479	43	507	
2011	1,200	256	272	5
2012	1,800	1,800	166	1
2013	13,500	9,800	70	3
2014	3,500	24,000	691	

2015	21,000	32,000	208
2016****	11,000	287,000	227

*	Testing period- Facility not fully functional.
**	Lifts began 5/5, however counts did not begin until 5/30.
***	Fishlift out of operation 6/2 - 6/18.
****	Expanded estimate of fish ascending the fish ladder at Pawtucket Falls.
*****	River herring counts include fish stocked by USFWS.

APPENDIX B

Appendix B: R script used to create summary data for each sampling point for import into Arc Gis.

```
##############################################################################
#                                                                            #
#              Linking fish sampling data to GIS                             #
#                Author: Jason Stolarski                                     #
#                                                                            #
#                                                                            #
#              last updated: feb 23  2018                                    #
#                                                                            #
#       NOTE: CFr saris's are pulled from No_dupes table                     #
#            in database which is assumed to be correct.                     #
#                                                                            #
#       NOTE: sample ids with no lat and longs, no corresponding row         #
#            in the sample information table                                 #
#            have been omitted from these analyses                           #
#                                                                            #
#       NOTE: cold/warm refers only to the presence (or absence)             #
#            of a naturally produced cold water species in a                 #
#            particular sample                                               #
#                                                                            #
#       NOTE: Brook Lamprey are included as a coldwater species              #
#                                                                            #
#                                                                            #
##############################################################################
```

```
#remove all previous objects
rm(list = ls())

options(digits=10)

#load functions
replace.na=function(x,y){
        z=rep(NA,length(x))
        for (u in 1:length(x)){
        if (is.na(x[u])) z[u]=y else
        z[u]=x[u]}
        z}

#install and load packages
#install.packages(c("RODBC","srtingr"))

library(stringr)
library(RODBC)
#library(WriteXLS)

#establish connection to ACCESS
channel=odbcDriverConnect("Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=W:/
fisherie/Fisheries Survey Database/Fisheries Survey and Inventory Database.accdb")

#extract data
```

```
len=sqlFetch(channel, "Length Frequency")
no_dupes=sqlFetch(channel, "No DUpes Saris/Palis")
fcode=sqlFetch(channel, "fcode")
sample=sqlFetch(channel, "Sample Information")
old=sqlFetch(channel, "old_fisheries_survey_data")
odbcClose(channel)

#manipulate for house keeping purposes
len=len[,1:4]
colnames(len)[3]="Fish.Code"

colnames(sample)[2]="saris_palis"
colnames(fcode)[1]="Fish.Code"

colnames(no_dupes)[1]="saris_palis"

old=old[complete.cases(old$unique_id),]

old=old[order(old$unique_id),]
##############################################################################
###
#prepare datalifes for data extraction

############establish cold and warmwater species
coldfish=na.omit(fcode[fcode$Temp=="C","Fish.Code"])
(warmfish=na.omit(fcode[!fcode$Fish.Code%in%coldfish,"Fish.Code"]))
```

```
####establish length cutoff for stocked fish
####aka < cutoff=natural
cutoff=150

#make trout vector
trout=c("EBT","BT","RT","TT","AS")

################################################################################
######

options(warn=2)

#one big loop to extract relevant information into table from new SIDs first

#establish data to loop on and remove sample ids with no fisheries information
all_samples=sort(unique(len$SampleID))
all_samples2=all_samples[all_samples%in%sample$SampleID]

#matrix to hold data
data=matrix(nrow=0,ncol=20)


for(i in all_samples2){

        #gather sample info
```

```
#saris palis
(saris_temp=sample[sample$SampleID==i,"saris_palis"])

#stream name
(name_temp=as.character(no_dupes[no_dupes$saris_palis==saris_temp,"Waterbody Name"]))

#waterbody type
if (saris_temp>99999) type_temp="Stream_River"
if (saris_temp<99999) type_temp="Lake_Pond"
type_temp

#CFR status
(cfr_temp=as.character(as.logical(no_dupes[no_dupes$saris_palis==saris_temp,"CFR"])))

#lat and long
(lat_temp=sample[sample$SampleID==i,"Latitude"])
(long_temp=-1*abs(sample[sample$SampleID==i,"Longitude"]))

#snapped lat and longs

(snlat_temp=sample[sample$SampleID==i,"snapped_latitude"])
(snlong_temp=-1*abs(sample[sample$SampleID==i,"snapped_longitude"]))

#date
(date_temp=as.character(sample[sample$SampleID==i,"Date"]))
```

```
#year
(year_temp=substr(as.character(sample[sample$SampleID==i,"Date"]),1,4))

#pickup type
(temp_pick=as.character(sample[sample$SampleID==i,"Sample Type"]))

#gear
(temp_gear=as.character(sample[sample$SampleID==i,"Method"]))

##########################Species

############warm

#subset length info for each sample and remove records containing all NA's
temp=len[len$SampleID==i,];(temp=temp[complete.cases(temp$Fish.Code),])

#Order alphabetically by species
temp=temp[order(temp$Fish.Code),]

#extract unique species and divide into warm subsets
(all_species=unique(temp$Fish.Code))
warm_temp=all_species[all_species%in%warmfish]

#account of samples with no warm water fish
if(length(as.character(warm_temp))>0){
```

```
#add counting variable

temp$to_count=1


#pad each fish.code with spaces to a common length

(warm_temp2=str_pad(na.omit(warm_temp),width=4,side="left",pad="-"))


#create naming vector for warm species

(sp_wrm_temp=paste(warm_temp2,collapse="|"))


#tack on one more| at the end to make all species formats the same for search
purposes

(sp_wrm_temp=paste0(sp_wrm_temp,"|"))


#remove first character from this string to get it to allign

#sp_wrm_temp=substr(sp_wrm_temp,2,nchar(sp_wrm_temp))


####abundances


#extract abundances

(abund_temp=(tapply(temp[temp$Fish.Code%in%warmfish,"to_count"],temp[temp$Fish.Code
%in%warmfish,"Fish.Code"],sum)))

abund_temp=na.omit(as.data.frame(abund_temp))


#format to common width for better presentation

abund_temp=sprintf("%04d",abund_temp[,1])
```

```
            #create paired abundance vector
            (abund_temp=paste(abund_temp,collapse="|"))

            #tack on one more| at the end to make all species formats the same for search
purposes
            (abund_temp=paste0(abund_temp,"|"))

            #check allingment
            sp_wrm_temp;abund_temp
                  }

      if(length(as.character(warm_temp))==0) {
            sp_wrm_temp="None"
            abund_temp=NA
                  }

      ###############cold

      #extract length data and remove all records with only NA's
      cold_length_all=temp[temp$Fish.Code%in%coldfish,]
      (cold_length_all=cold_length_all[complete.cases(cold_length_all$Fish.Code),])

      #Marker          to indicate in later process when there are no coldwater fish
      trace=TRUE
```

```
if(nrow(cold_length_all)>0){

#marker to indicate in later process when there are no coldwater fish
trace=FALSE

cold_length_all$to_count=1

#add unique number
cold_length_all$uniq_id=1:nrow(cold_length_all)

########designate cold or warm sample (contains naturally reproduced cld water fish)
#remove AS as their presence in a stream is not considered toward cfr status
fudge=cold_length_all[cold_length_all$Fish.Code!="AS",]

#does the sample contain cld water fish <cutoff or LT
(cold_designation=ifelse(any(na.omit(fudge$length)<cutoff)| any(fudge$Fish.Code=="LT"),"TRUE","FALSE"))

##################exceptions must be altered after the fact

#######create species name vector
cold_temp=unique(cold_length_all$Fish.Code)

if(length(as.character(cold_temp))>0){

#pad each fish.code with spaces to a common length
```

```
(cold_temp2=str_pad(na.omit(cold_temp),width=4,side="left",pad="-"))

#create naming vector for warm species
(sp_cold_temp2=paste(cold_temp2,collapse="|"))

#tack on one more| at the end to make all species formats the same for search purposes
(sp_cold_temp2=paste0(sp_cold_temp2,"|"))

#remove first character from this string to get it to allign
#(sp_cold_temp=substr(sp_cold_temp2,2,nchar(sp_cold_temp2)))

#####abundances

#extract abundances
(abund_temp2=(tapply(cold_length_all[,"to_count"],cold_length_all[,"Fish.Code"],sum)))
abund_temp2=na.omit(as.data.frame(abund_temp2))

#format to common width for better presentation
abund_temp2=sprintf("%04d",abund_temp2[,1])

#create paired abundance vector
(abund_temp2=paste(abund_temp2,collapse="|"))

#tack on one more| at the end to make all species formats the same for search purposes
```

```
            (abund_temp2=paste0(abund_temp2,"|"))

            #check allingment
            sp_cold_temp2;abund_temp2

                }

        if(length(as.character(cold_temp))==0) {
            (sp_cold_temp2="None")
            (abund_temp2=NA)}

        #min and max ebt length
        ebt_length=cold_length_all[cold_length_all$Fish.Code=="EBT","length"]
        ebt_length=as.vector(na.omit(ebt_length))

        if(length(ebt_length)>0) {
            min_ebt=min(ebt_length)
            max_ebt=max(ebt_length)}

        if(length(ebt_length)==0){
            (min_ebt=NA)
            (max_ebt=NA)}
        }

    #need this because cold_length_nat does not exist if there are no naturally produced coldwater fish
```

```
        if(trace) {
                cold_designation="FALSE"
                sp_cold_temp2="None"
                abund_temp2=NA
                min_ebt=NA
                max_ebt=NA}


        #bring all the data together

temp_data=c(i,saris_temp,name_temp,type_temp,cfr_temp,lat_temp,long_temp,date_temp,year_
temp,temp_pick,temp_gear,sp_wrm_temp,abund_temp,cold_designation,sp_cold_temp2,abund_t
emp2,min_ebt,max_ebt,snlat_temp,snlong_temp)


        #append
        data=rbind(data,temp_data)


        ###remove all variables before next loop

keep=c("all_samples","all_samples2","channel","coldfish","warmfish","cutoff","i","data","fcode
","len","no_dupes","old","replace.na","sample","trout","fcode")


        rm(list= ls()[!(ls() %in% keep)])


        }


colnames(data)=c("SampleID","saris_palis","waterbody_name","waterbody_type","CFR","latitu
de","longitude","date","year","sample_type","gear","warmwater_species","warmwater_abundan
```

ces","contains_nat._prod._cldwtr._fish","coldwater_species","coldwater_abundances","min_EBT_length","max_EBT_length","snapped_latitude","snapped_longitude")

##Old data

##Old data

##Old data

##Old data

##Old data

##Old data

##Old data

#########preparation to extract

####deal with species name differences

#change fish names

colnames(old)[colnames(old)=="UNIDMINNOW"]="Unk_Minnow"

colnames(old)[colnames(old)=="EBT<140mm"]="EBT"

colnames(old)[colnames(old)=="BT<140mm"]="BT"

colnames(old)[colnames(old)=="RT<140mm"]="RT"

colnames(old)[colnames(old)=="Johnny_Darter"]="JDR"

colnames(old)[colnames(old)=="Flounder"]="FLD"

```
colnames(old)[colnames(old)=="Silversides"]="ATS"
colnames(old)[colnames(old)=="Menhaden"]="MNH"
colnames(old)[colnames(old)=="Herring"]="BBH"
colnames(old)[colnames(old)=="CPXNP"]="CPNP"
colnames(old)[colnames(old)=="RPXCP"]="RPCP"

#remove vauge occurances
old=old[!colnames(old)%in%c("FLD","MNH"),]

#extract vector of all species

#add column to sum all fish occurances
old$fish_total=apply(old[,15:85],1,sum)
old$nat_trout=apply(old[,c("EBT","BT","RT")],1,sum)
old$stock_trout=apply(old[,c("EBT>140mm","BT>140mm","RT>140mm")],1,sum)

#####set up vector of cold and warm water species
coldfish=sort(c("EBT","EBT>140mm","BT","BT>140mm","RT","RT>140mm","SC","LNS","LCS","BL","AS","RS"))
warmfish=sort(colnames(old)[15:85][!colnames(old)[15:85]%in%coldfish])

#move Unk_minnow to end of the list for listing purposes later
warmfish=warmfish[!warmfish%in%"Unk_Minnow"]
warmfish=c(warmfish,"Unk_Minnow")

#create stocked and natural vector
```

```
stocked=c("EBT>140mm","BT>140mm","RT>140mm","AS")

#######set up vector to loop over

#remove sites with no coordinates
old_sites=old[complete.cases(old$latitude),]
old_sites=old_sites[complete.cases(old_sites$longitude),]

#remove sites with no fish data and records with all NA's
old_sites=old_sites[old_sites$fish_total>0,]
old_sites=old_sites[complete.cases(old_sites$unique_id),]

#create matrix to hold results
old_results=matrix(nrow=0,ncol=20)

for(q in sort(old_sites$unique_id)){

	#sample_id add 10000 to make it unique from modern records which range from 1 to 5000
	(sampleID_temp=10000 +q)

	#saris_palis
	(saris_temp=old_sites[old_sites$unique_id==q,"saris_palis"])

	#waterbody name
	(name_temp=as.character(no_dupes[no_dupes$saris_palis==saris_temp,"Waterbody Name"]))
```

```
#waterbody type
if (saris_temp>99999) type_temp="Stream_River"
if (saris_temp<99999) type_temp="lake_pond"
type_temp

#CFR status

(cfr_temp=paste0(as.character(as.logical(no_dupes[no_dupes$saris_palis==saris_temp,"CFR"]))
))

#lat and long
(lat_temp=old_sites[old_sites$unique_id==q,"latitude"])
(long_temp=-1*abs(old_sites[old_sites$unique_id==q,"longitude"]))

#use snapped inside coords for historic lentic samples
if(saris_temp<99999){
        (lat_temp=no_dupes[no_dupes$saris_palis==saris_temp,"Latitude"])
        (long_temp=-1*abs(no_dupes[no_dupes$saris_palis==saris_temp,"Longitude"]))
                }

#snapped lat and longs

(snlat_temp=old_sites[old_sites$unique_id==q,"snapped_latitude"])
(snlong_temp=-1*abs(old_sites[old_sites$unique_id==q,"snapped_longitude"]))

#use snapped inside coords for historic lentic samples
```

```
        if(saris_temp<99999){
                (snlat_temp=no_dupes[no_dupes$saris_palis==saris_temp,"Latitude"])
(snlong_temp=-1*abs(no_dupes[no_dupes$saris_palis==saris_temp,"Longitude"]))
                                }

        #date
        (date_temp=as.character(old_sites[old_sites$unique_id==q,"sample_date"]))

        #year
        (year_temp=old_sites[old_sites$unique_id==q,"sample_year"])

        #pickup type
        (temp_pick="Unknown")

        #gear
        temp_gear=(as.character(old_sites[old_sites$unique_id==q,"method"]))
        if(temp_gear%in%c("zero","one","two","three","five","seven","nine"))
temp_gear="Unknown"
        temp_gear

        ############Fish Data

        ####warm fish

        #species list
```

```
warm_sp=t(old_sites[old_sites$unique_id==q,colnames(old_sites)%in%warmfish])

warm_sp=as.data.frame(cbind(rownames(warm_sp),warm_sp));colnames(warm_sp)=c("Fish.Code","n")

warm_sp$Fish.Code=as.character(warm_sp$Fish.Code);warm_sp$n=as.numeric(as.character(warm_sp$n))

#sort to place unk_minnow at end of vector
warm_sp=warm_sp[order(match(warm_sp[,1],warmfish)),]

#extract abundances and species list
(abund_temp=warm_sp[as.numeric(warm_sp[,2])>0,"n"])
(warm_sp=warm_sp[as.numeric(warm_sp[,2])>0,"Fish.Code"])

#account for a sample with no warm water fish
if(length(warm_sp)>0){

    tracer=FALSE

    #deal with Unk_minnow, too long to be placed in vector, have to make special accomidation at end if it is present
    if ("Unk_Minnow"%in%warm_sp){
        warm_sp=warm_sp[!warm_sp%in%"Unk_Minnow"]
        tracer=TRUE}

    #pad each fish.code with spaces to a common length
    (warm_sp=str_pad(na.omit(warm_sp),width=4,side="left",pad="-"))
```

```
#create naming vector for warm species
(sp_wrm_temp=paste(warm_sp,collapse="|"))

#add back minnow if present
if(tracer){
        (sp_wrm_temp=paste(sp_wrm_temp,"| Unk_Minnow"))}

#tack on one more| at the end to make all species formats the same for search
purposes
(sp_wrm_temp=paste0(sp_wrm_temp,"|"))

#abundances

#deal with minnow
if(tracer){
        #extract and pad minnow abundance
        min_abund=abund_temp[length(as.numeric(abund_temp))]
        abund_temp=sprintf("%04d",as.numeric(abund_temp))

        #remove minnow abundance from vector
        abund_temp=abund_temp[-(length(abund_temp))]}

#pad with zeros to constant length
abund_temp=sprintf("%04d",as.numeric(abund_temp))
```

```
            #create paired abundance vector
            (abund_temp=paste(abund_temp,collapse="|"))

            #place minnow abund back if present
            if(tracer){
                  abund_temp=paste(abund_temp,"|   ",min_abund)}

            #tack on one more| at the end to make all species formats the same for search
purposes
            (abund_temp=paste0(abund_temp,"|"))

            rm(tracer)

            #chech allignment
            sp_wrm_temp;abund_temp

            }

      #account for a sample with no warmwater fish
      if(length(warm_sp)==0){
            sp_wrm_temp="None"
            abund_temp="NA"}

      ###########cold fish
      cold_sp=t(old_sites[old_sites$unique_id==q,colnames(old_sites)%in%coldfish])
```

```
cold_sp=as.data.frame(cbind(rownames(cold_sp),cold_sp));colnames(cold_sp)=c("Fish.Code","
n")

cold_sp$Fish.Code=as.character(cold_sp$Fish.Code);cold_sp$n=as.numeric(as.character(cold_s
p$n))

        #extract species list
        (cold_sp2=cold_sp[as.numeric(cold_sp[,2])>0,"Fish.Code"])

        #contains nat rep. cold water fish or not
        (cold_sp_tmp=cold_sp2[!cold_sp2%in%stocked])
        (cold_designation=ifelse(length(cold_sp_tmp)>0,"TRUE","FALSE"))

        #generate abundance vector
        if(sum(cold_sp$n)>0){

                #combine trout categories for tallying
                comb=as.data.frame(rbind(c("EBT",(cold_sp[1,2]+cold_sp[2,2])),c("BT",
(cold_sp[3,2]+cold_sp[4,2])),c("RT",(cold_sp[5,2]+cold_sp[6,2]))))
                colnames(comb)=colnames(cold_sp)
                comb[,1]=as.character(comb[,1]);comb[,2]=as.numeric(as.character(comb[,2]))
                cold_sp=rbind(comb,cold_sp[-c(1:6),])

(cold_name=str_pad(na.omit(cold_sp[cold_sp$n>0,1]),width=4,side="left",pad="-"))
                (cold_name=paste(cold_name,collapse="|"))
```

```
            #tack on one more| at the end to make all species formats the same for search
purposes
            (cold_name=paste0(cold_name,"|"))

            #extract abundances
            (abund_cold=cold_sp[cold_sp$n>0,2])

            #pad with zeros to common length and collapse
            (abund_cold=sprintf("%04d",as.numeric(abund_cold)) )
            (abund_cold=paste(abund_cold,collapse="|"))

            #tack on one more| at the end to make all species formats the same for search
purposes
            (abund_cold=paste0(abund_cold,"|"))

            cold_name;abund_cold}

        if(sum(cold_sp$n)==0){
            cold_name="None"
            abund_cold=NA}

        #no lengths
        min_ebt=NA;max_ebt=NA

        #####put it all together

temp_data=c(sampleID_temp,saris_temp,name_temp,type_temp,cfr_temp,lat_temp,long_temp,d
```

```
ate_temp,year_temp,temp_pick,temp_gear,sp_wrm_temp,abund_temp,cold_designation,cold_name,abund_cold,min_ebt,max_ebt,snlat_temp,snlong_temp)


        #append

        old_results=rbind(old_results,temp_data)


        #remove objects

keep=c("channel","coldfish","warmfish","cutoff","q","data","fcode","len","no_dupes","old","old_sites","old_species","old_results","stocked","replace.na","sample","trout","fcode")


        rm(list= ls()[!(ls() %in% keep)])


        }


colnames(old_results)=c("SampleID","saris_palis","waterbody_name","waterbody_type","Saris_CFR","latitude","longitude","date",",year","sample_type","gear","warmwater_species","warmwater_abundances","contains_nat._prod._cldwtr._fish","coldwater_species","coldwater_abundances","min_EBT_length","max_EBT_length","snapped_latitude","snapped_longitude")


##########################################################end loop for old sample data

#####################################################

#####################################################

#####################################################


data2=as.data.frame(rbind(data,old_results),row.names=FALSE)


#dont mess with my data R
```

```
data2[,1]=as.numeric(as.character(data2[,1]))

data2[,2]=as.numeric(as.character(data2[,2]))


data2[,8]=as.character(data2[,8])

data2[,13]=as.character(data2[,13])

data2[,16]=as.character(data2[,16])

#################################################################END LOOP

######################fix exceptions

#sid's that contain trout larger than 140 or 150 but that are naturally produced as noted on data sheets

#580,456,604,1665,3375,3959,3638,5285


exceptions=c(580,444,455,456,604,1665,3375,3959,3638,5285,5640,7028,3869,5285,1283,2656,5899,

        6090,2377,4719,5333,5221,5334,4737,455,3373,1981,1983,5220)

####

data2[data2[,1]==580,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==444,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==455,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==456,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==604,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==1665,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==3375,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==3959,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==3638,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==5285,"contains_nat._prod._cldwtr._fish"]="TRUE"

data2[data2[,1]==5640,"contains_nat._prod._cldwtr._fish"]="TRUE"
```

```
data2[data2[,1]==7028,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==3869,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5285,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==1283,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==2656,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5899,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==6090,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==2377,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==4719,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5333,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5221,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5334,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==4737,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==455,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==3373,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==1981,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==1983,"contains_nat._prod._cldwtr._fish"]="TRUE"
data2[data2[,1]==5220,"contains_nat._prod._cldwtr._fish"]="TRUE"



#####
#####order
data4=data2[order(data2$SampleID),]


###################add last sampled column
###################
```

```
##################get all saris

saris=sort(no_dupes$saris_palis)
saris=sort(unique(saris[saris%in%data4$saris_palis]))

last_sampled=rep(NA,length(saris))
count=0

for (i in saris){
        count=count+1
        temp=sample[sample$saris_palis==i,"Date"]
        (temp4=as.numeric(substr(temp,1,4)))

        (temp2=old[old$saris_palis==i,"sample_year"])

        tempy=sort(c(temp4,temp2))

        if (length(tempy)>0){(last_sampled[count]=tempy[length(tempy)])}

        if (length(tempy)==0){
                (last_sampled[count]=0)}
        }

information=as.data.frame(cbind(saris,last_sampled))
colnames(information)=c("saris","last_sampled")
```

```
data4$Last_sampled_in=rep(NA,nrow(data4))

for(r in 1:nrow(data4)){
	test=data4[r,"saris_palis"]
	data4[r,"Last_sampled_in"]=information[information$saris==test,2]}

##################################Add hyperlinks to datasheets

path2="W:/fisherie/Scanned River Files/Watersheds"

#get all saris folders
#do this way rather than search for files as folders with no modern .pdf will be missed

dir1=dir(path2,full.names = TRUE, recursive = FALSE,pattern="[123456789]{1}")
dir1[-grep("pdf",dir1)]

sub_dirs=character(length=0)

#dir2
for(i in dir1){
	dir2=dir(i,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{2}")
	if(length(grep("pdf",dir2))>0) {dir2=dir2[-grep("pdf",dir2)]}

	for (x in dir2){
		dir3=dir(x,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{7}")
		if(length(grep("pdf",dir3))>0) {dir3=dir3[-grep("pdf",dir3)]}
```

```
                sub_dirs=c(sub_dirs,dir3)}

                }

#to trick arcgis into thinking path is a hyperlink
prefix="file:///"

temp_saris=(rep(NA,length(sub_dirs)))
temp_path=(rep(NA,length(sub_dirs)))
count=0

for(i in sub_dirs){
        count=count+1
        (strt=gregexpr("/",i)[[1]][6])
        (stp=gregexpr("/",i)[[1]][7])

        (temp_saris[count]=substr(i,start=strt+1,stop=strt+7))
        (temp_path[count]=paste0(prefix,sub_dirs[count]))
        }

hyper=cbind(temp_saris,temp_path)

#attach to datasets
path_cold=rep(NA,nrow(data4))
```

```
for(i in 1:nrow(data4)){
        tempx=as.numeric(data4[i,2])
        tempy=na.omit(hyper[hyper[,1]==tempx,2])[1]
        if(length(tempy)==0) path_cold[i]=NA
        if(length(tempy)==1)path_cold[i]=tempy
                }

data4=cbind(data4,path_cold)
data4$path_cold=as.character(data4$path_cold)

##################################add hyperlinks to lake files
path4="W:/fisherie/Scanned Pond Files"
lake_path=list.files(path4,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{5}")

#attach prefix to trick ARC GIS into thinking its a URL

lake_path=paste0(prefix,lake_path)

#extract palis number
palis=rep(NA,length(lake_path))
for (i in 1:length(palis)){
        palis[i]=as.numeric(substr(lake_path[i],nchar(lake_path[i])-4,nchar(lake_path[i])))
        }

#combine datasets
lake_path=as.data.frame(cbind(lake_path,palis))
```

```
#palis to number

lake_path[,2]=as.numeric(as.character(lake_path[,2]))

##############


#figure out which palis just have historic files

p_out=lake_path[!lake_path[,2]%in%data2[,2],]


#make dummy rows for these data

dummy_lake=as.data.frame(matrix(ncol=7,nrow=0))

colnames(dummy_lake)=c("saris_palis","waterbody_name","waterbody_type","latitude","longit
ude","Last_sampled_in","historical_data_link")


#loop throuth p_out to make new table to export later

for(rr in p_out$palis){

        tempxy=as.data.frame(matrix(ncol=7,nrow=0))


colnames(tempxy)=c("saris_palis","waterbody_name","waterbody_type","latitude","longitude","
Last_sampled_in","historical_data_link")



        (tempxy[1,"saris_palis"]=as.numeric(rr))


(tempxy[1,"waterbody_name"]=as.character(no_dupes[no_dupes$saris_palis==rr,"Waterbody
Name"]))

        (tempxy[1,"waterbody_type"]="lake_pond")

        (tempxy[1,"latitude"]=no_dupes[no_dupes$saris_palis==rr,"Latitude"])

        (tempxy[1,"longitude"]=-1*abs(no_dupes[no_dupes$saris_palis==rr,"Longitude"]))

        (tempxy[1,"historical_data_link"]=as.character(lake_path[lake_path$palis==rr,1]))

        (tempxy[1,"Last_sampled_in"]="no_sampling_history")
```

```
        dummy_lake=rbind(dummy_lake,tempxy)

        }
###############

#attach paths to data4 which have been sampled to larger dataset
#place in same col as lotic datasheet hyperlinks
###########

for(i in 1:nrow(data4)){

        if(data4[i,"saris_palis"]>100000) next
        test=data4[i,"saris_palis"]

        data4[i,"path_cold"]=as.character(lake_path[as.numeric(lake_path[,2])==test,1])

        }

#check to see if any samples do not have a electronic folder
#data4[is.na(data4$path_cold),]


################################Add hyperlinks to picture files
path3="U:/Sections/Fisheries/archive/Stream Survey Pictures"
```

```
#get directory list
pics=list.dirs(path3,full.names=TRUE)

#remove dir without SID's
SID=grep("SID",pics)
SID2=pics[SID]

#create vector to hold SID's
SID3=rep(NA,length(SID2))

#Remove subfolders within SID folders and extracs SID's
for (i in 1:length(SID2)){
        temp=str_locate(SID2[i],"SID")[2]
        if(nchar(SID2[i])==(temp+5)){ x=substr(SID2[i],temp+1,temp+5)
                x=as.numeric(as.character(x))
                SID3[i]=x}
        if(nchar(SID2[i])!=(temp+5)) {SID3[i]=NA}
                }

# combine records and remove NA's
pics2=cbind(data.frame(SID2),SID3)
pics2=na.omit(pics2)
colnames(pics2)=c("p_path","SID")

#attach prefix to trick ARC GIS into thinking its a URL
prefix="file:///"
```

```
pics2[,1]=paste0(prefix,pics2[,1])

#######Attach to larger dataset

picture_path_cold=rep(NA,nrow(data4))

for(i in 1:nrow(data4)){
        temp=pics2[pics2$SID==as.numeric(data4[i,1]),1]

        if(length(temp)==0) picture_path_cold[i]=NA
        if(length(temp)>0) picture_path_cold[i]=as.character(temp)
                }

data5=cbind(data4,picture_path_cold)

################

colnames(data5)[c(22,23)]=c("Link_to_data_sheets","Link_to_pictures")

################NEED TO REFORTMAT COLS AGAIN ONCE HAVE THE ENTIRE TABLE

#format
data5[,3]=as.character(data5[,3])
data5[,7]=as.character(-1*(abs(as.numeric(as.character(data5[,7])))))
data5[,6]=as.character(abs(as.numeric(as.character(data5[,6]))))
```

```
data5[,9]=as.numeric(as.character(data5[,9]))
data5[,12]=as.character(data5[,12])

data5[,15]=as.character(data5[,15])
data5[,17]=as.numeric(as.character(data5[,17]))
data5[,18]=as.numeric(as.character(data5[,18]))

data5[,19]=as.character(data5[,19])
data5[,20]=as.character(data5[,20])
data5[,21]=as.numeric(as.character(data5[,21]))
data5[,22]=as.character(data5[,22])
data5[,23]=as.character(data5[,23])



##########################extract
#setwd("P:/linking_fish_data_to_gis")
setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018")

#write.table(data5,gsub("-","_",paste0("fish_data_samples_",Sys.Date(),".txt")),row.names=FAL
SE,sep=",")

write.csv(data5,gsub("-","_",paste0("fish_data_",Sys.Date(),".csv")),row.names=FALSE)
write.table(data5,gsub("-","_",paste0("fish_data_",Sys.Date(),".txt")),row.names=FALSE)



##########################################export lake and ponds with historic data only
for seperate layer
```

```
########################################
########################################
#########################
#########################
#streams
#search watersheds folder for all 0000000 folders
path2="W:/fisherie/Scanned River Files/Watersheds"

#get all saris folders
#do this way rather than search for files as folders with no modern .pdf will be missed

sub_dirs=as.character()

dir1=dir(path2,full.names = TRUE, recursive = FALSE,pattern="[123456789]{1}")
dir1=dir1[-grep("pdf",dir1)]

for(i in dir1){
        dir2=dir(i,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{2}")
        if(length(grep("pdf",dir2))>0) {dir2=dir2[-grep("pdf",dir2)]}

        for (x in dir2){
                dir3=dir(x,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{7}")
                if(length(grep("pdf",dir3))>0) {dir3=dir3[-grep("pdf",dir3)]}

                sub_dirs=c(sub_dirs,dir3)}
                }
```

```
####################add 2 digit basin code,  name, and saris

temp_saris=(rep(NA,length(sub_dirs)))
saris_abrv=(rep(NA,length(sub_dirs)))
temp_name=(rep(NA,length(sub_dirs)))
temp_path=(rep(NA,length(sub_dirs)))
count=0
prefix="file:///"

for(i in sub_dirs){
        count=count+1
        (strt=gregexpr("/",i)[[1]][6])

        (temp_saris[count]=substr(i,start=strt+1,stop=strt+7))
        (temp_path[count]=paste0(prefix,sub_dirs[count]))

        (strt=gregexpr("/",i)[[1]][6]-3)
        (stp=gregexpr("/",i)[[1]][6]-2)
        (saris_abrv[count]=substr(i,start=strt,stop=stp))

        (strt=gregexpr("-",i)[[1]][1]+2)
        if(gregexpr(",",i)[[1]][1]>0){stp=gregexpr(",",i)[[1]][1]-1}
        if(gregexpr(",",i)[[1]][1]<0){stp=nchar(i)}
        (temp_name[count]=substr(i,start=strt,stop=stp))
```

```
        }

hyper=as.data.frame(cbind(temp_saris,saris_abrv,temp_name,temp_path))
hyper[,1]=as.numeric(as.character(hyper[,1]))
hyper[,2]=as.numeric(as.character(hyper[,2]))
hyper[,3]=as.character(hyper[,3])
hyper[,4]=as.character(hyper[,4])



#import coords
setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018")
hist_coords=read.csv("hist_strms.csv",header=TRUE,sep=",")

#loop through stream names and break names apart for later matching
hist_coords$proper_name=rep("NA",nrow(hist_coords))
for(i in 1:nrow(hist_coords)){
        test=unlist(gregexpr(" ",hist_coords[i,2]))[length(unlist(gregexpr(" ",hist_coords[i,2])))]
        hist_coords$proper_name[i]=substr(hist_coords[i,2],1,test-1)}
hist_coords=hist_coords[order(hist_coords$GNIS_Name),]

#match correct path to gis layer containing coordinates
str_path=rep(NA,length(hist_coords))

for(i in 1:nrow(hist_coords)){

        temp_search=hyper[hyper$saris_abrv==hist_coords[i,3],]
```

```
	if(hist_coords[i,3]>0){

		str_path[i]=hyper[hyper$temp_saris==hist_coords[i,3],4]}


	if(hist_coords[i,"FIRST_saris"]==0){

		temp_search=hyper[hyper$saris_abrv==hist_coords[i,6] &
hyper$temp_saris==0,]


		gotit=grep(hist_coords[i,"proper_name"],temp_search$temp_name)


		str_path[i]=temp_search[gotit,4]}


		}


	hist_coords2=cbind(hist_coords,str_path)


########reformat hist_coords 2 to match dummy_lake from above

#rbind hist_coords2 with dummy and export for a layer containg waters with historic data only



hist_coords3=cbind(hist_coords2[,c(3,2)],rep("Stream_River",nrow(hist_coords2)),hist_coords2[
,c(4,5)],

	rep("no_sampling_history",nrow(hist_coords2)),hist_coords2[,c(9)])


colnames(hist_coords3)=colnames(dummy_lake)


hist_coords3[,2]=as.character(hist_coords3[,2])
```

```
hist_coords3[,3]=as.character(hist_coords3[,3])

hist_coords3[,6]=as.character(hist_coords3[,6])

hist_coords3[,7]=as.character(hist_coords3[,7])


historic_data=rbind(dummy_lake,hist_coords3)


#change waterbody name to sentence case

historic_data$waterbody_name=tolower(historic_data$waterbody_name)

historic_data$waterbody_name=tools::toTitleCase(historic_data$waterbody_name)


##########export

setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018")


write.csv(historic_data,gsub("-","_",paste0("historic_data_",Sys.Date(),".csv")),row.names=FAL
SE)


################################################################################
################################

################################################################################
################################

################################################################################
################################


#####################################################################

#                                   #

#       Fishless sites                  #

#                                   #
```

```
#########################################################################

#remove all previous objects
rm(list = ls())

options(digits=10)
options(warn=2)

#load functions
replace.na=function(x,y){
z=rep(NA,length(x))
for (u in 1:length(x)){
if (is.na(x[u])) z[u]=y else
z[u]=x[u]}
z}

#install and load packages
#install.packages(c("RODBC","srtingr"))

library(stringr)
library(RODBC)

#establish connection to ACCESS

channel=odbcDriverConnect("Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=W:/
fisherie/Fisheries Survey Database/Fisheries Survey and Inventory Database.accdb")
```

```
#extract data
len=sqlFetch(channel, "Length Frequency")
no_dupes=sqlFetch(channel, "No DUpes Saris/Palis")
sample=sqlFetch(channel, "Sample Information")
old=sqlFetch(channel, "old_fisheries_survey_data")

odbcClose(channel)

#manipulate for house keeping purposes
len=len[,1:4]
colnames(len)[3]="Fish.Code"

colnames(sample)[2]="saris_palis"

colnames(no_dupes)[1]="saris_palis"

old=old[sort(old$unique_id),]
###################################

#######figure out which sampling points have no fisheries data associated with them

##all sampling sites
temp=sample[,1]

#fish sites
```

```
fish=unique(len$SampleID)

#ones without data

nofish=sort(temp[!temp%in%fish])

#########sites labeled as fishless

nofish_samp=sample[sample[,14]==1,1]

#########no sample conducted
no_samp=sample[sample[,28]==1,1]

#check to see if all fish without fish data are labeled as fishless or no sample conducted
nofish[!nofish%in%c(nofish_samp,no_samp)]

#########combine

no_data=sort(unique(c(nofish,nofish_samp,no_samp)))

dataless=matrix(nrow=0,ncol=16)

#########extract relevant information

tmp1=rep(NA,length(no_data))
tmp2=rep(NA,length(no_data))
```

```
tmp3=rep(NA,length(no_data))
tmp4=rep(NA,length(no_data))
tmp5=rep(NA,length(no_data))
tmp6=rep(NA,length(no_data))
tmp7=rep(NA,length(no_data))
tmp8=rep(NA,length(no_data))
tmp9=rep(NA,length(no_data))
tmp10=rep(NA,length(no_data))
tmp11=rep(NA,length(no_data))
tmp12=rep(NA,length(no_data))
tmp13=rep(NA,length(no_data))
tmp14=rep(NA,length(no_data))
tmp15=rep(NA,length(no_data))

count=0

for (i in no_data){

count=count+1

#gather sample info
#saris palis
(tmp1[count]=sample[sample$SampleID==i,"saris_palis"])

#stream name
(tmp2[count]=as.character(no_dupes[no_dupes$saris_palis==tmp1[count],"Waterbody Name"]))
```

```
#waterbody type
if (tmp1[count]>99999) tmp3[count]="Stream_River"
if (tmp1[count]<99999) tmp3[count]="lake_pond"
tmp3[count]

#CFR status
(tmp4[count]=as.character(as.logical(no_dupes[no_dupes$saris_palis==tmp1[count],"CFR"])))

#lat and long
(tmp5[count]=sample[sample$SampleID==i,"Latitude"])
(tmp6[count]=-1*abs(sample[sample$SampleID==i,"Longitude"]))

(tmp13[count]=sample[sample$SampleID==i,"snapped_latitude"])
(tmp14[count]=-1*abs(sample[sample$SampleID==i,"snapped_longitude"]))
#date
(tmp7[count]=as.character(sample[sample$SampleID==i,"Date"]))

#year
(tmp15[count]=substr(as.character(sample[sample$SampleID==i,"Date"]),1,4))

#pickup type
(tmp8[count]=as.character(sample[sample$SampleID==i,"Sample Type"]))

#gear
(tmp9[count]=as.character(sample[sample$SampleID==i,"Method"]))
```

```
#Fish_less_sample
(tmp10[count]=as.character(as.logical(sample[sample$SampleID==i,"Fishless Sample"])))

#no_sample conducted
(tmp11[count]=as.character(as.logical(sample[sample$SampleID==i,"No Sample Conducted"])))

#habitat_comment
(tmp12[count]=as.character(sample[sample$SampleID==i,"Habitat Comment"]))
if (nchar(tmp12[count])==0 | replace.na(tmp12[count],0)==0) tmp12[count]="None"

dumb=c("-","!","#","-",":",";",",","/","=")
for (a in dumb){
tmp12[count]=gsub(a," ",tmp12[count])}
tmp12[count]
#condence to 255 characters for gis.  otherwise records with greater than 255 are deleted
if (nchar(tmp12[count])>255) tmp12[count]=substr(tmp12[count],1,255)

}

dataless=as.data.frame(cbind(no_data,tmp1,tmp2,tmp3,tmp4,tmp5,tmp6,tmp7,tmp15,tmp8,tmp9,
tmp10,tmp11,tmp12,tmp13,tmp14))
dataless$tmp1=as.numeric(as.character(dataless$tmp1))
dataless$tmp2=as.character(dataless$tmp2)
dataless$tmp3=as.character(dataless$tmp3)
dataless$tmp4=as.character(dataless$tmp4)
```

```
dataless$tmp5=as.numeric(as.character(dataless$tmp5))

dataless$tmp6=as.numeric(as.character(dataless$tmp6))

dataless$tmp7=as.character(dataless$tmp7)

dataless$tmp8=as.character(dataless$tmp8)

dataless$tmp9=as.character(dataless$tmp9)

dataless$tmp10=as.character(dataless$tmp10)

dataless$tmp11=as.character(dataless$tmp11)

dataless$tmp12=as.character(dataless$tmp12)

dataless$tmp13=as.numeric(as.character(dataless$tmp13))

dataless$tmp14=as.numeric(as.character(dataless$tmp14))

dataless$no_data=as.numeric(as.character(dataless$no_data))

dataless$tmp15=as.numeric(as.character(dataless$tmp15))


colnames(dataless)=c("SampleID","saris_palis","waterbody_name","waterbody_type","CFR","la
titude","longitude","date","year","sample_type","gear","Fishless_Sample","No_sample_conduct
ed","Habitat_comment","snapped_latitude","snapped_longitude")



############################################################old data, why?

#get all fishless sites

old$fish_total=apply(old[,15:85],1,sum)


old2=old[old$fish_total==0,]


#remove sites with no lat and longs

old3=old2[old2$latitude >0,]
```

```
#remove NA's
old4=old3[complete.cases(old3$latitude),]

#get sids
sid=old4$unique_id

tmp_1=rep(NA,length(sid))
tmp_2=rep(NA,length(sid))
tmp_3=rep(NA,length(sid))
tmp_4=rep(NA,length(sid))
tmp_5=rep(NA,length(sid))
tmp_6=rep(NA,length(sid))
tmp_7=rep(NA,length(sid))
tmp_8=rep(NA,length(sid))
tmp_9=rep(NA,length(sid))
tmp_10=rep(NA,length(sid))
tmp_11=rep(NA,length(sid))
tmp_12=rep(NA,length(sid))
tmp_13=rep(NA,length(sid))
tmp_14=rep(NA,length(sid))
tmp_15=rep(NA,length(sid))
tmp_16=rep(NA,length(sid))

count=0

####loop through sids to get relevant info
```

```
for (i in sid){


count=count+1


tmp_1[count]=i+10000


#gather sample info

#saris palis

(tmp_2[count]=na.omit(old[old$unique_id==i,"saris_palis"]))


#stream name

(tmp_3[count]=as.character(no_dupes[no_dupes$saris_palis==tmp_2[count],"Waterbody
Name"]))


#waterbody type

if (tmp_2[count]>99999) tmp_4[count]="Stream_River"

if (tmp_2[count]<99999) tmp_4[count]="lake_pond"

tmp_4[count]


#CFR status

(tmp_5[count]=as.character(as.logical(no_dupes[no_dupes$saris_palis==tmp_2[count],"CFR"]))
)


#lat and long

(tmp_6[count]=na.omit(old[old$unique_id==i,"latitude"]))

(tmp_7[count]=na.omit(-1*abs(old[old$unique_id==i,"longitude"])))
```

```
#snapped coords(if any)

if(length(na.omit(old[old$unique_id==i,"snapped_latitude"]))>0){

tmp_14[count]=na.omit(old[old$unique_id==i,"snapped_latitude"])

tmp_15[count]=na.omit(-1*abs(old[old$unique_id==i,"snapped_longitude"]))}


#date

if(length(na.omit(old[old$unique_id==i,"sample_date"]))>0)
{tmp_8[count]=as.character(na.omit((old[old$unique_id==i,"sample_date"])))}


#year

(tmp_16[count]=na.omit(as.numeric(as.character(old[old$unique_id==i,"sample_year"]))))


#pickup type

(tmp_9[count]="Unknown")


#gear

(tmp_10[count]="Unknown")


#Fish_less_sample

(tmp_11[count]="TRUE")


#no_sample conducted

(tmp_12[count]="Unkown")


#habitat_comment
```

```
(tmp_13[count]="None")



}



old2=as.data.frame(cbind(tmp_1,tmp_2,tmp_3,tmp_4,tmp_5,tmp_6,tmp_7,tmp_8,tmp_16,tmp_9
,tmp_10,tmp_11,tmp_12,tmp_13,tmp_14,tmp_15))


old2$tmp_1=as.numeric(as.character(old2$tmp_1))

old2$tmp_2=as.numeric(as.character(old2$tmp_2))

old2$tmp_3=as.character(old2$tmp_3)

old2$tmp_4=as.character(old2$tmp_4)

old2$tmp_5=as.character(old2$tmp_5)

old2$tmp_6=as.numeric(as.character(old2$tmp_6))

old2$tmp_7=as.numeric(as.character(old2$tmp_7))

old2$tmp_8=as.character(old2$tmp_8)

old2$tmp_9=as.character(old2$tmp_9)

old2$tmp_10=as.character(old2$tmp_10)

old2$tmp_11=as.character(old2$tmp_11)

old2$tmp_12=as.character(old2$tmp_12)

old2$tmp_13=as.character(old2$tmp_13)

old2$tmp_14=as.numeric(as.character(old2$tmp_14))

old2$tmp_15=as.numeric(as.character(old2$tmp_15))

old2$tmp_16=as.numeric(as.character(old2$tmp_16))
```

```
colnames(old2)=c("SampleID","saris_palis","waterbody_name","waterbody_type","CFR","latitude","longitude","date","year","sample_type","gear","Fishless_Sample","No_sample_conducted","Habitat_comment","snapped_latitude","snapped_longitude")

####################combine old and new data


dataless2=rbind(dataless,old2)


##########################

###################add last sampled column


#get all saris


saris=sort(no_dupes$saris_palis)

saris=saris[saris%in%dataless2$saris_palis]


last_sampled=rep(NA,length(saris))

count=0


for (i in saris){

count=count+1

temp=sample[sample$saris_palis==i,"Date"]

(temp4=as.numeric(substr(temp,1,4)))


(temp2=old[old$saris_palis==i,"sample_year"])


tempy=sort(c(temp4,temp2))
```

```
if (length(tempy)>0){(last_sampled[count]=tempy[length(tempy)])}

if (length(tempy)==0){
(last_sampled[count]=0)}
}

information=as.data.frame(cbind(saris,last_sampled))
colnames(information)=c("saris","last_sampled")

test=rep(NA,nrow(dataless2))
count=0

for(r in dataless2$saris_palis){
count=count+1
test[count]=paste0(information[information$saris==r,2],".")}

dataless2$Last_sampled_in=as.character(test)
rm(tempy,temp2,temp4)

##############################################################links

#################################Add hyperlinks to datasheets

path2="W:/fisherie/Scanned River Files/Watersheds"

#get all saris folders
```

```
#do this way rather than search for files as folders with no modern .pdf will be missed

dir1=dir(path2,full.names = TRUE, recursive = FALSE,pattern="[123456789]{1}")
dir1[-grep("pdf",dir1)]

sub_dirs=character(length=0)

#dir2
for(i in dir1){
dir2=dir(i,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{2}")
if(length(grep("pdf",dir2))>0) {dir2=dir2[-grep("pdf",dir2)]}

for (x in dir2){
dir3=dir(x,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{7}")
if(length(grep("pdf",dir3))>0) {dir3=dir3[-grep("pdf",dir3)]}

sub_dirs=c(sub_dirs,dir3)}

}

#to trick arcgis into thinking path is a hyperlink
prefix="file:///"

temp_saris=(rep(NA,length(sub_dirs)))
temp_path=(rep(NA,length(sub_dirs)))
count=0
```

```
for(i in sub_dirs){
count=count+1
(strt=gregexpr("/",i)[[1]][6])
(stp=gregexpr("/",i)[[1]][7])

(temp_saris[count]=substr(i,start=strt+1,stop=strt+7))
(temp_path[count]=paste0(prefix,sub_dirs[count]))
}

hyper=cbind(temp_saris,temp_path)

#attach to datasets
path_cold=rep(NA,nrow(dataless2))

for(i in 1:nrow(dataless2)){
tempx=as.numeric(dataless2[i,2])
tempy=na.omit(hyper[hyper[,1]==tempx,2])[1]
if(length(tempy)==0) path_cold[i]=NA
if(length(tempy)==1)path_cold[i]=tempy
}

dataless2=cbind(dataless2,path_cold)
dataless2[,18]=as.character(dataless2[,18])
#attach lake file paths
```

```
path4="W:/fisherie/Scanned Pond Files"
lake_path=list.files(path4,full.names = TRUE, recursive = FALSE,pattern="[1234567890]{5}")

#attach prefix to trick ARC GIS into thinking its a URL
lake_path=paste0(prefix,lake_path)

#extract palis number
palis=rep(NA,length(lake_path))
for (i in 1:length(palis)){
palis[i]=as.numeric(substr(lake_path[i],nchar(lake_path[i])-4,nchar(lake_path[i])))
}

#combine datasets
lake_path=cbind(lake_path,palis)

#attach to larger dataset
###########cold_data

for(i in 1:nrow(dataless2)){

        if(dataless2[i,"saris_palis"]<=99999 & dataless2[i,"saris_palis"]
%in%as.numeric(as.character(lake_path[,2]))){
                dataless2[i,"path_cold"]=as.character(lake_path[lake_path[,
2]==dataless2[i,"saris_palis"],1])}

                }
```

```
#################################Add hyperlinks to picture files
path3="U:/Sections/Fisheries/archive/Stream Survey Pictures"

#get directory list
pics=list.dirs(path3,full.names=TRUE)

#remove dir without SID's
SID=grep("SID",pics)
SID2=pics[SID]

#create vector to hold SID's
SID3=rep(NA,length(SID2))

#Remove subfolders within SID folders and extracs SID's
for (i in 1:length(SID2)){
        temp=str_locate(SID2[i],"SID")[2]
        if(nchar(SID2[i])==(temp+5)){ x=substr(SID2[i],temp+1,temp+5)
                x=as.numeric(as.character(x))
                SID3[i]=x}
        if(nchar(SID2[i])!=(temp+5)) {SID3[i]=NA}
                }

# combine records and remove NA's
pics2=cbind(data.frame(SID2),SID3)
pics2=na.omit(pics2)
```

```
colnames(pics2)=c("p_path","SID")

#attach prefix to trick ARC GIS into thinking its a URL
pics2[,1]=paste0(prefix,pics2[,1])

#######Attach to larger dataset

picture_path_cold=rep(NA,nrow(dataless2))

for(i in 1:nrow(dataless2)){
        temp=pics2[pics2$SID==as.numeric(dataless2[i,1]),1]

        if(length(temp)==0) picture_path_cold[i]=NA
        if(length(temp)>0) picture_path_cold[i]=as.character(temp)
                }

dataless3=cbind(dataless2,picture_path_cold)

################

colnames(dataless3)=c("SampleID","saris_palis","waterbody_name","waterbody_type","CFR","l
atitude","longitude","date","year","sample_type","gear","Fishless_Sample","No_sample_conduc
ted","Habitat_comment","snapped_latitude","snapped_longitude","Last_sampled_in","Link_to_
datasheet","Link_to_pictures")
################
```

##########extract

setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018")

write.csv(dataless3,gsub("-","_",paste0("fishless_samples_",Sys.Date(),".csv")),row.names=FALSE)

write.table(dataless3,gsub("-","_",paste0("fishless_samples_",Sys.Date(),".txt")),row.names=FALSE)

##########

Appendix B: R script used to import snapped coordinates back into fisheries database

```
#remove all previous objects
rm(list = ls())

options(digits=10)
options(warn=2)



#load functions
replace.na=function(x,y){
        z=rep(NA,length(x))
        for (u in 1:length(x)){
        if (is.na(x[u])) z[u]=y else
        z[u]=x[u]}
        z}

#install and load packages
#install.packages(c("RODBC","srtingr"))

library(stringr)
library(RODBC)
#library(WriteXLS)
library(stringi)

#establish connection to ACCESS
```

```
channel=odbcDriverConnect("Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=W:/
fisherie/Fisheries Survey Database/Fisheries Survey and Inventory Database.accdb")


#extract data

len=sqlFetch(channel, "Length Frequency")

no_dupes=sqlFetch(channel, "No DUpes Saris/Palis")

fcode=sqlFetch(channel, "fcode")

sample=sqlFetch(channel, "Sample Information")

old=sqlFetch(channel, "old_fisheries_survey_data")

odbcClose(channel)


#manipulate for house keeping purposes

len=len[,1:4]

colnames(len)[3]="Fish.Code"


colnames(sample)[2]="saris_palis"

colnames(fcode)[1]="Fish.Code"


colnames(no_dupes)[1]="saris_palis"


old=old[order(old[,1]),]


#order

sample=sample[order(sample$SampleID),]

old=old[order(old$unique_id),]
```

```
setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018")

topaste=read.csv("fish_snapped_coords_to_paste.csv",header=TRUE,sep=",")

######################place in snapped lotic lats and longs

for(i in 1:nrow(topaste)){
        sid=topaste[i,"SampleID"]
        pal=topaste[i,"saris_palis"]

        if(sid<9999 & pal>99999){

sample[sample$SampleID==sid,"snapped_latitude"]=topaste[topaste$SampleID==sid,"snapped_
latitude"]

sample[sample$SampleID==sid,"snapped_longitude"]=topaste[topaste$SampleID==sid,"snappe
d_longitude"]}

        if(sid<9999 & pal<=99999){

sample[sample$SampleID==sid,"snapped_latitude"]=no_dupes[no_dupes$saris_palis==pal,"Lati
tude"]

sample[sample$SampleID==sid,"snapped_longitude"]=no_dupes[no_dupes$saris_palis==pal,"L
ongitude"]}
```

```
        if(sid>9999 & pal>99999){


        sid=sid-10000

old[na.omit(old$unique_id)==sid,"snapped_latitude"]=topaste[topaste$SampleID==sid+10000,"
snapped_latitude"]

old[na.omit(old$unique_id)==sid,"snapped_longitude"]=topaste[topaste$SampleID==sid+10000
,"snapped_longitude"]}


        if(sid>9999 & pal<=99999){
        sid=sid=10000

old[na.omit(old$unique_id)==sid,"snapped_latitude"]=no_dupes[no_dupes$saris_palis==pal,"La
titude"]

old[na.omit(old$unique_id)==sid,"snapped_longitude"]=no_dupes[no_dupes$saris_palis==pal,"
Longitude"]}


                }


######fill in remaining ponds with snapped coords from no_dupes
#######sample_information
for(i in 1:nrow(sample)){
        if(sample[i,"saris_palis"]<99999 & (is.na(sample[i,"snapped_latitude"]) |
is.na(sample[i,"snapped_longitude"]))){


                temp_palis=sample[i,"saris_palis"]
```

```
sample[i,"snapped_latitude"]=no_dupes[no_dupes$saris_palis==temp_palis,"Latitude"]

sample[i,"snapped_longitude"]=no_dupes[no_dupes$saris_palis==temp_palis,"Longitude"]}}


#old_survey_database

for(i in 1:nrow(old)){

        if(old[i,"saris_palis"]<99999 & (is.na(old[i,"snapped_latitude"]) |
is.na(old[i,"snapped_longitude"]))){


                temp_palis=old[i,"saris_palis"]

old[i,"snapped_latitude"]=no_dupes[no_dupes$saris_palis==temp_palis,"Latitude"]


old[i,"snapped_longitude"]=no_dupes[no_dupes$saris_palis==temp_palis,"Longitude"]}}

write.csv(sample[,c(1,2,30,31)],"snapped_coords_to_add_back_after_r_processing.csv",row.nam
es=FALSE)

write.csv(old[,c(1,2,88,89)],"snapped_coords_to_add_back_after_r_processing_old.csv",row.na
mes=FALSE)
```

Appendix C: R script used to create data summaries for sampling points that would be released publically on Mass GIS.

```
##############################################################################
#                                                                            #
#              Linking fish sampling data to GIS (PUBLIC)                    #
#                Author: Jason Stolarski                                     #
#                                                                            #
#                                                                            #
#                last updated: jan 30  2018                                  #
#                                                                            #
#                                                                            #
#       NOTE: sample ids with no lat and longs, no corresponding row         #
#            in the sample information table                                 #
#            have been omitted from these analyses                           #
#                                                                            #
#                                                                            #
#                                                                            #
##############################################################################


#remove all previous objects
rm(list = ls())


options(digits=10)


#load functions
replace.na=function(x,y){
```

```
    z=rep(NA,length(x))
    for (u in 1:length(x)){
    if (is.na(x[u])) z[u]=y else
    z[u]=x[u]}
    z}

#install and load packages
#install.packages(c("RODBC","srtingr"))

library(stringr)
library(RODBC)
#library(WriteXLS)
library(stringi)

#establish connection to ACCESS
channel=odbcDriverConnect("Driver={Microsoft Access Driver (*.mdb, *.accdb)};DBQ=W:/
fisherie/Fisheries Survey Database/Fisheries Survey and Inventory Database.accdb")

#extract data
len=sqlFetch(channel, "Length Frequency")
no_dupes=sqlFetch(channel, "No DUpes Saris/Palis")
fcode=sqlFetch(channel, "fcode")
sample=sqlFetch(channel, "Sample Information")
old=sqlFetch(channel, "old_fisheries_survey_data")
odbcClose(channel)
```

```
#manipulate for house keeping purposes
len=len[,1:4]
colnames(len)[3]="Fish.Code"

colnames(sample)[2]="saris_palis"
colnames(fcode)[1]="Fish.Code"

colnames(no_dupes)[1]="saris_palis"

old=old[sort(old$unique_id),]

#######remove sensitive species
len=len[!len$Fish.Code%in%c("BM","LC","LNS","BBT","ESM","BL","BBT","SNS","TSS"),]

##############################################################################
###
#prepare datalifes for data extraction

##############################################################################
######

options(warn=2)

#one big loop to extract relevant information into table from new SIDs first

#establish data to loop on and remove sample ids with no fisheries information
all_samples=sort(unique(len$SampleID))
```

```
all_samples2=all_samples[all_samples%in%sample$SampleID]

#matrix to hold data
data=matrix(nrow=0,ncol=11)



for(i in all_samples2){

        #account for sample with no species data
        if (length(len[len$SampleID==i,"Fish.Code"])==0) next

        #remove DEP samples
        if(length(grep("DEP",as.character(sample[sample$SampleID==i,"Method"])))>0) next

        #gather sample info
        #saris palis
        (saris_temp=sample[sample$SampleID==i,"saris_palis"])

        #stream name
        (name_temp=as.character(no_dupes[no_dupes$saris_palis==saris_temp,"Waterbody
Name"]))

        #waterbody type
        if (saris_temp>99999) type_temp="Stream_River"
        if (saris_temp<99999) type_temp="Lake_Pond"
        type_temp
```

```
#lat and long
(lat_temp=sample[sample$SampleID==i,"Latitude"])
(long_temp=-1*(abs(sample[sample$SampleID==i,"Longitude"])))

#date
(date_temp=as.character(sample[sample$SampleID==i,"Date"]))

#year
(year=as.numeric(substr(sample[sample$SampleID==i,"Date"],1,4)))

#pickup type
(temp_pick=as.character(sample[sample$SampleID==i,"Sample Type"]))

#gear
(temp_gear=as.character(sample[sample$SampleID==i,"Method"]))

##########################Species

#subset length info for each sample and remove records containing all NA's
temp=len[len$SampleID==i,];(temp=temp[complete.cases(temp$Fish.Code),])

#Order alphabetically by species
temp=temp[order(temp$Fish.Code),]

#extract unique species
```

```
(all_species=unique(temp$Fish.Code))

#account of samples with fish
#add counting variable
temp$to_count=1

#pad each fish.code with spaces to a common length
(all_species2=str_pad(na.omit(all_species),width=4,side="left",pad=" "))

#create naming vector for warm species
(all_species2=paste(all_species2,collapse="|"))

#tack on one more| at the end to make all species formats the same for search purposes
(all_species2=paste0(all_species2,"|"))

#remove first character from this string to get it to allign
(all_species2=substr(all_species2,2,nchar(all_species2)))

#bring all the data together

temp_data=c(i,saris_temp,name_temp,type_temp,lat_temp,long_temp,date_temp,year,temp_pick
,temp_gear,all_species2)

#append
data=rbind(data,temp_data)

###remove all variables before next loop
```

```
keep=c("all_samples","all_samples2","channel","i","data","fcode","len","no_dupes","old","replace.na","sample","trout","fcode")

        rm(list= ls()[!(ls() %in% keep)])

        }

colnames(data)=c("SampleID","saris_palis","waterbody_name","waterbody_type","latitude","longitude","date","year","sample_type","gear","species_code")

#################################################################Old data

#########preparation to extract

####deal with species name differences

#change fish names
colnames(old)[colnames(old)=="UNIDMINNOW"]="Unk_Minnow"
colnames(old)[colnames(old)=="EBT<140mm"]="EBT"
colnames(old)[colnames(old)=="BT<140mm"]="BT"
colnames(old)[colnames(old)=="RT<140mm"]="RT"

colnames(old)[colnames(old)=="Johnny_Darter"]="ETH"
colnames(old)[colnames(old)=="Flounder"]="FLD"
colnames(old)[colnames(old)=="Silversides"]="SLV" #Atherinopsidae
colnames(old)[colnames(old)=="Menhaden"]="MNH"
```

```
colnames(old)[colnames(old)=="Herring"]="BBH"

colnames(old)[colnames(old)=="CPXNP"]="CPNP"

colnames(old)[colnames(old)=="RPXCP"]="RPCP"


#remove cols

#remove stocked fish to place focus on what we think were naturally produced fish

old=old[,!colnames(old)
%in%c("RPCP","CPNP","FLD","Unk_Minnow","EBT>140mm","BT>140mm","RT>140mm")]


#remove sensitive species

old=old[,!colnames(old)%in%c("BM","LC","LNS","ESM","BL")]


#remove vague species

old=old[,!colnames(old)%in%c("FLD","SLV","MNH")]


#extract vector of all species


#add column to sum all fish occurances

old$fish_total=apply(old[,15:72],1,sum)


#######set up vector to loop over


#remove sites with no coordinates

old_sites=old[complete.cases(old$latitude),]

old_sites=old_sites[complete.cases(old_sites$longitude),]
```

```
#remove sites with no fish data and records with all NA's
old_sites=old_sites[old_sites$fish_total>0,]
old_sites=old_sites[complete.cases(old_sites$unique_id),]

#order
old_sites=old_sites[order(old_sites$unique_id),]

#create matrix to hold results
old_results=matrix(nrow=0,ncol=11)

for(q in sort(old_sites$unique_id)){

	#sample_id add 10000 to make it unique from modern records which range from 1 to 5000
	(sampleID_temp=10000 +q)

	#saris_palis
	(saris_temp=old_sites[old_sites$unique_id==q,"saris_palis"])

	#waterbody name
	(name_temp=as.character(no_dupes[no_dupes$saris_palis==saris_temp,"Waterbody Name"]))

	#waterbody type
	if (saris_temp>99999) type_temp="Stream_River"
	if (saris_temp<99999) type_temp="Lake_Pond"
	type_temp
```

```
#lat and long
(lat_temp=old_sites[old_sites$unique_id==q,"latitude"])
(long_temp=-1*(abs(old_sites[old_sites$unique_id==q,"longitude"])))

#sample date
(date_temp=as.character(old_sites[old_sites$unique_id==q,"sample_date"]))

#year
(year_temp=as.character(old_sites[old_sites$unique_id==q,"sample_year"]))

#pickup type
(temp_pick="Unknown")

#gear
temp_gear=(as.character(old_sites[old_sites$unique_id==q,"method"]))
if(temp_gear%in%c("zero","one","two","three","five","seven","nine",NA))
temp_gear="Unknown"
temp_gear

##########Fish Data
#species list

sp=t(old_sites[old_sites$unique_id==q,c(15:72)])
sp=as.data.frame(cbind(row.names(sp),sp))
sp[,2]=as.numeric(as.character(sp[,2]))
```

```
        sp2=sort(as.character(sp[sp[,2]>0,1]))

        #pad each fish.code with spaces to a common length
        (sp2=str_pad(na.omit(sp2),width=4,side="left",pad=" "))

        #create naming vector for warm species
        (sp3=paste(sp2,collapse="|"))
        (sp3=paste0(sp3,"|"))



        #####put it all together

temp_data=c(sampleID_temp,saris_temp,name_temp,type_temp,lat_temp,long_temp,date_temp,
year_temp,temp_pick,temp_gear,sp3)
        #append
        old_results=rbind(old_results,temp_data)

        #remove objects

keep=c("channel","cutoff","q","data","fcode","len","no_dupes","old","old_sites","old_species","
old_results","replace.na","sample","fcode")

        rm(list= ls()[!(ls() %in% keep)])

        }

colnames(old_results)=c("SampleID","saris_palis","waterbody_name","waterbody_type","latitu
de","longitude","date","year","sample_type","gear","species_code")
```

```
data2=as.data.frame(rbind(data,old_results),row.names=FALSE)

#dont mess with my data R
data2[,1]=as.numeric(as.character(data2[,1]))
data2[,2]=as.numeric(as.character(data2[,2]))
data2[,3]=as.character(data2[,3])
data2[,5]=as.numeric(as.character(data2[,5]))
data2[,6]=as.numeric(as.character(data2[,6]))
data2[,7]=as.character(data2[,7])
data2[,8]=as.character(data2[,8])
data2[,11]=as.character(data2[,11])

#change waterbody name to sentence case
data2$waterbody_name=tolower(data2$waterbody_name)
data2$waterbody_name=tools::toTitleCase(data2$waterbody_name)

##################################################################END LOOP

#########################extract
setwd("W:/Gisdata/Fish/jason/snap_points/snap_points_2018/public_gis_layer")

#write.table(data2,paste0("public_fisheries_layer_",Sys.Date(),".txt"),row.names=FALSE)
write.csv(data2,paste0("public_fisheries_layer_",Sys.Date(),".csv"),row.names=FALSE)
```